Quaestiones Entomologicae

A periodical record of entomological investigations, published at the Department of Entomology, University of Alberta, Edmonton, Canada.

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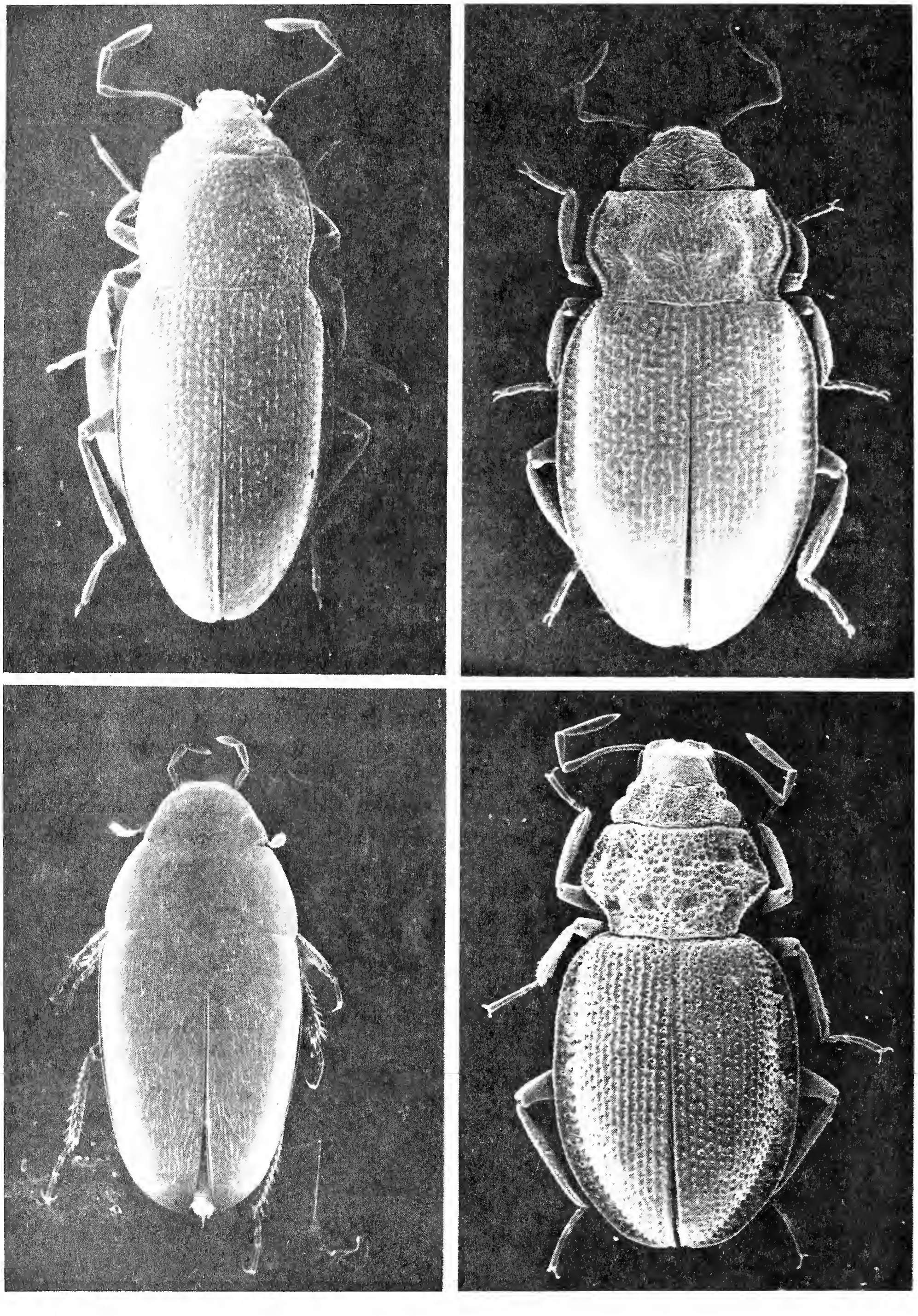

Fig. 1. Dorsal habitus of (clockwise from top left) *Hydraena marginicollis*, *Hydraena cuspidicollis*, *Spanglerina brevis* and *Limnebius alutaceus* (not to same scale).

AQUATIC BEETLES OF THE FAMILY HYDRAENIDAE IN THE WESTERN HEMISPHERE: CLASSIFICATION, BIOGEOGRAPHY AND INFERRED PHYLOGENY (INSECTA: COLEOPTERA)

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The aquatic beetle family Hydraenidae in the Western Hemisphere includes nine genera and 206 species. One genus, Spanglerina *(type species* S. ingens *new species), is described as new; two genera,* Gymnochthebius *and* Neochthebius, *are elevated from subgeneric rank. New species (142) are described in the following genera:* Hydraenida *(1),* Parhydraenida *(5),* Hydraena *(77),* Spanglerina *(3),* Limnebius *(11),* Gymnochthebius *(14),* Ochthebius *(30) and* Meropathus *(1). New synonomies are proposed in* Hydraena *(1),* Limnebius *(3),* Gymnochthebius *(2) and* Ochthebius *(7).*

Taxonomically and phylogenetically significant structures are illustrated with line drawings or scanning electron micrographs, and geographical distributions are mapped. Natural history data are noted for genera and, when available, species. Keys to genera, species groups, and species are given.

Morphological features unique to the family, including abdominal and aedeagal structure, are discussed with respect to homologies, and illustrated. Internal reproductive systems of representative species are illustrated and discussed.

Phylogenetic relationships of the genera are proposed using inferred synapotypic character states of larvae (external) and adults (external and internal). As a result, a new subfamily, Ochthebiinae, is proposed, the Hydraeninae is redefined and the Limnebiinae is reduced to subtribal rank. Geographical distributions of genera and species groups are briefly discussed with respect to continental drift, global distribution and available fossil data.

Phylogenetic relationships of all species and species groups are presented in phylograms, together with generalized distribution maps to illustrate repetitive vicariance patterns and serve as a data base for further studies of historical biogeography. Vicariance zones are proposed based upon coincident sister-group patterns. North American and some Middle American vicariance zones are discussed relative to paleogeological events. Based upon coincidence of vicariance zones and paleogeological events, dichotomies are placed in mid-Cretaceous, Miocene, Pliocene, and Pleistocene times. Endemism is discussed relative to vicariance zones.

The following new species are described (type localities parenthetic): Hydraenida robusta *(Maule, Chile);* Parhydraenida bubrunipes *(Nova Teutonia, Santa Catarina, Brazil),* Parhydraenida hygropetrica *(Santa Teresa, Espirito Santo, Brazil),* Parhydraenida lambda *(Jaguariaiva, Parana, Brazil),* Parhydraenida paralonga *(Campos do Jordao, Säo Paulo, Brazil),* Parhydraenida pentatenkta *(Portoviejo, Manabi, Ecuador);* Spanglerina fluvicola *(Oaxaca, Mexico),* Spanglerina frondsicola *(Nayarit, Mexico),* Spanglerina ingens *(Mexico, Mexico);* Limnebius arenicolus *(Los Angeles Co., California),*

Limnebius aridus *(Hidalgo Co., New Mexico),* Limnebius borealis *(British Columbia, Canada),* Limnebius leechi *(Mendocino Co., California),* Limnebius mexicanus *(Oaxaca, Mexico),* Limnebius mitus *(Zacatecas, Mexico),* Limnebius octolaevis *(Totonicapan, Guatemala),* Limnebius ozapalachicus *(Bath Co., Virginia),* Limnebius richmondi *(Lewis Co., New York),* Limnebius texanus *(Culberson Co., Texas),* Limnebius utahensis *(Wasatch Mts., Utah);* Gymnochthebius bartyrae *(Lima, Peru),* Gymnochthebius bisagittatus *(Cundinamarca, Colombia),* Gymnochthebius clandestinus *(Maule, Chile),* Gymnochthebius compactus *(Paranâ, Brazil),* Gymnochthebius curvus *(Valdivia, Chile),* Gymnochthebius falli *(Logan Co., Kansas),* Gymnochthebius maureenae *(George Co., Mississippi),* Gymnochthebius octonarius *(Tucuman, Argentina),* Gymnochthebius oppositus *(Baja California, Mexico),* Gymnochthebius perlabidus *(Limon, Costa Rica),* Gymnochthebius plesiotypus *(Concepcion region, Chile),* Gymnochthebius reticulatissimus *(Tucuman, Argentina),* Gymnochthebius seminole *(Monroe Co., Florida),* Gymnochthebius tectus *(Maule, Chile);* Meropathus vectis *(Isla de los Estados, Argentina).*

New species of Ochthebius *are:* Ochthebius alpinopetrus *(Natrona Co., Wyoming),* Ochthebius angularidus *(Coahuila, Mexico),* Ochthebius apache *(Cochise Co, Arizona),* Ochthebius arenicolus *(Colusa Co., California),* Ochthebius arizonicus *(Gila Co., Arizona),* Ochthebius biincisus *(Monterey Co., California),* Ochthebius bisinuatus *(Trinity Co., California),* Ochthebius borealis *(Glenn Co., California),* Ochthebius brevipennis *(Tillamook Co., Oregon),* Ochthebius browni *(Mexico, Mexico),* Ochthebius californicus *(Tulare Co., California),* Ochthebius crassalus *(Ventura Co., California),* Ochthebius gruwelli *(Baja California, Mexico),* Ochthebius hibernus *(Oregon),* Ochthebius lecontei *(British Columbia, Canada),* Ochthebius madrensis *(Cochise Co., Arizona),* Ochthebius mesoamericanus *(Jalapa, Guatemala),* Ochthebius mexicanus *(Mexico, Mexico),* Ochthebius mexcavatus *(Durango, Mexico),* Ochthebius orbus *(Marin Co., California),* Ochthebius pacificus *(Sonoma Co., California),* Ochthebius pauli *(Oaxaca, Mexico),* Ochthebius recticulus *(Colusa Co., California),* Ochthebius rectusalsus *(Contra Costa Co., California),* Ochthebius reticulocostus *(Mexico, Mexico),* Ochthebius richmondi *(Humboldt Co., California),* Ochthebius sculptoides *(Ventura Co., California),* Ochthebius sierrensis *(Fresno Co., California),* Ochthebius tubus *(Baja California, Mexico),* Ochthebius uniformis *(San Francisco Co., California).*

New species of Hydraena *are:* Hydraena alternata *(Durango, Mexico),* Hydraena alterra *(Minas Gerais, Brazil),* Hydraena anaphora *(Matto Grosso, Brazil),* Hydraena ancylis *(York Co., Pennsylvania),* Hydraena anisonycha *(Cundinamarca, Colombia),* Hydraena appalachicola *(Bath Co., Virginia),* Hydraena arenicola *(Lake Co., California),* Hydraena arizonica *(Santa Cruz Co., Arizona),* Hydraena argutipes *(Durango, Mexico),* Hydraena atlantica *(Montgomery Co., Maryland),* Hydraena barricula *(Chiapas, Mexico),* Hydraena bituberculata *(Cochise Co., Arizona),* Hydraena bractea *(Durango, Mexico),* Hydraena bractoides *(Durango, Mexico),* Hydraena breedlovei *(Durango, Mexico),* Hydraena browni *(Guarico, Venezuela),* Hydraena californica *(Marin Co., California),* Hydraena campbelli *(Chiapas, Mexico),* Hydraena canticacollis *(Zacatecas, Mexico),* Hydraena chiapa *(Chiapas, Mexico),* Hydraena circulata *(Butte Co., California),* Hydraena colombiana *(Cundinamarca, Colombia),* Hydraena colymba *(Jalapa, Guatemala),* Hydraena costiniceps *(Salta, Argentina),* Hydraena crystallina *(Jalisco, Mexico),* Hydraena cuspidicollis *(Oaxaca, Mexico),* Hydraena d-destina *(Chiapas, Mexico),* Hydraena exilipes *(Tamaulipas, Mexico),* Hydraena geminya *(Oaxaca, Mexico),* Hydraena guatemala *(Escuintla, Guatemala),* Hydraena haitensis *(Etang Lachaux, Haiti),* Hydraena hyalina *(Guarico, Venezuela),* Hydraena jivaro *(Napo, Ecuador),*

Hydraena leechi *(Coconino Co., Arizona)*, Hydraena limpidicollis *(Canal Zone, Panama)*, Hydraena malkini *(Tres Rios, Costa Rica)*, Hydraena maureenae *(Bath Co., Virginia)*, Hydraena mazamitla *(Jalisco, Mexico)*, Hydraena mexicana *(Chiapas, Mexico)*, Hydraena mignymixys *(Lake Co., California)*, Hydraena nevermanni *(Reventazon, Costa Rica)*, Hydraena newtoni *(Canal Zone, Panama)*, Hydraena oaxaca *(Oaxaca, Mexico)*, Hydraena oblio *(Baja Verapaz, Guatemala)*, Hydraena occidentalis *(Mendocino Co., California)*, Hydraena orcula *(Goias, Brazil)*, Hydraena ozarkensis *(McDonald Co., Missouri)*, Hydraena pacifica *(British Columbia, Canada)*, Hydraena paeminosa *(Zanderij, Surinam)*, Hydraena particeps *(Guarico, Venezuela)*, Hydraena pavicula *(Lima, Peru)*, Hydraena peru *(Huanuco, Peru)*, Hydraena petila *(Tehama Co., California)*, Hydraena pontequula *(Canal Zone, Panama)*, Hydraena premordica *(Mayaro, Trinidad)*, Hydraena prieto *(Durango, Mexico)*, Hydraena pulsatrix *(Tamaulipas, Mexico)*, Hydraena quadricurvipes *(Chattooga Co., Georgia)*, Hydraena quechua *(Los Rios, Ecuador)*, Hydraena sabella *(Chiapas, Mexico)*, Hydraena scintilla *(Oaxaca, Mexico)*, Hydraena scintillabella *(Cundinamarca, Colombia)*, Hydraena scintillutea *(Minas Gerais, Brazil)*, Hydraena scolops *(Mexico, Mexico)*, Hydraena scopula *(Jalisco, Mexico)*, Hydraena sierra *(Madera Co., California)*, Hydraena spangleri *(Montgomery Co., Maryland)*, Hydraena splecoma *(Chiapas, Mexico)*, Hydraena terralta *(Minas Gerais, Brazil)*, Hydraena trinidensis *(St. Augustine, Trinidad)*, Hydraena tucumanica *(Tucuman, Argentina)*, Hydraena tuolumne *(Tuolumne Co., California)*, Hydraena turrialba *(Turrialba, Costa Rica)*, Hydraena vela *(Nayarit, Mexico)*, Hydraena yosemitensis *(Mariposa Co., California)*, Hydraena youngi *(Alachua Co., Florida)*, Hydraena zapatina *(Jalisco, Mexico)*.

The following new synonymies are proposed (junior names parenthetic): Limnebius alutaceus *(Casey) (*L. columbianus *Brown*, L. congener *Casey)*, L. angustulus *(Casey) (*L. coniciventris *(Casey));* Gymnochthebius fossatus *(LeConte) (*G. nitiduloides *(d'Orchymont)*, G. parvulus *(Sharp));* Ochthebius interruptus *LeConte (*O. aberti *Hatch)*, O. aztecus *Sharp (*O. bruesi *Darlington)*, O. marinus *(Paykull) (*O. holmbergi *Mäklin)*, O. discretus *LeConte (*O. insulanus *Brown)*, O. lineatus *LeConte* (O. milleri *Hatch*), Ochthebius attritus *LeConte (*O. schubarti *d'Orchymont)*, Ochthebius similis *Sharp (*O. wickhami *Fall);* Hydraena punctata *LeConte (*H. needhami *d'Orchymont)*.

La famille de coléoptères aquatiques des Hydraenidae compte, dans l'hémisphère ouest, neuf genres et 206 espèces. Un genre nouveau, Spanglerina *(espèce type,* S. ingens, *espèces nouveau), est décrit; les sous-genres* Gymnochthebius *et* Neochthebius *sont élevés au rang de genre. Un total de 142 espèces nouvelles sont décrites dans les genres suivants:* Hydraenida *(1)*, Parhydraenida *(5)*, Hydraena *(77)*, Spanglerina *(3)*, Limnebius *(11)*, Gymnochthebius *(14)*, Ochthebius *(30) et* Meropathus *(1). De nouveaux synonymes sont proposés dans les genres* Hydraena *(1)*, Limnebius *(3)*, Gymnochthebius *(2) et* Ochthebius *(7).*

Les structures d'une importance taxonomique et phylogénétique particulière sont illustrées par des dessins ou des photos prises au microscope à balayage électronique; la répartition géographique des taxons est présentée sur des cartes. Les données d'histoire naturelle sont présentées pour chaque genre et, lorsque disponibles, pour les espèces. Des clés d'identification sont fournies pour les genres, les groupes d'espèces et les espèces.

Les caractères morphologiques uniques à la famille sont illustrés et discutés en relation avec leurs homologues, et incluent des structures de l'abdomen et de l'édéage. Les parties internes du système reproducteur d'espèces représentatives sont illustrées et discutées.

Les relations phylogénétiques des genres sont établies à partir de synapotypies des larves (caractères externes seulement) et des adultes (caractères externes et internes). En conséquence, une nouvelle sous-famille, celle des

Ochthebiinae, est proposée, les Hydraeninae sont redéfinis et les Limnebiinae sont abaissés au rang de sous-tribu. La répartition géographique des genres et des groupes d'espèces est brièvement discutée en relation avec la dérive des continents, la distribution globale de la famille et les fossiles disponibles.

Les relations phylogénétiques de toutes les espèces et de tous les groupes d'espèces sont illustrées par des phylogrammes; à celles-ci sont adjointes des cartes illustrant les distributions généralisées, qui montrent les patrons répétitifs de vicariance et qui pourront servir de données de base pour des études éventuelles sur la biogéographie historique. Les zones de vicariance sont déterminées à partir des distributions coïncidentes de groupes apparentés. Les zones de vicariance de l'Amérique du Nord et de l'Amérique Centrale sont discutées en rapport avec des évènements paléontologiques. Suivant la coïncidence des zones de vicariance et les évènements paléontologiques qui leur sont associés, les dichotomies devraient dater du Crétacé Moyen, du Miocène, du Pliocène et du Pléistocène. Les cas d'endémisme sont interprétés en rapport avec les zones de vicariance.

Les noms des espèces nouvelles (ainsi que les localités types) sont énumérés dans le résumé anglais.

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INTRODUCTION

Adults of Hydraenidae are minute aquatic beetles, most of which are slightly less than 2.00 mm long and found at the margins of aquatic habitats, especially streams. They have been

termed "minute moss beetles" by some, but in actuality a very small percentage of species are associated with moss. Most species live in sandy or gravelly aquatic situations, therefore, a more appropriate common name for the family might be "micropsammophilous aquatic beetles".

Generalities regarding the habits of the family are difficult to make since, as in any consideration of a rather large evolutionary unit, exceptions abound. Hence, various kinds of hydraenid beetles live in such diverse aquatic habitats as hot springs, cold mountain streams, rapid tropical cascades, saline beach pools, cracks in rocks covered at high tide, and vertical rock faces in hygropetric habitats.

Although the family is relatively small in most respects, including size of individuals, number of species and generic diversity, from an evolutionary and biogeographic viewpoint it is one of the most interesting members of the series Staphyliniformia. Hydraenids have a curious combination of characters and habits which have resulted in their placement with the primitive Staphylinoidea by some authors, and with the Hydrophiloidea by others.

The family has not been studied in a collective, monographic manner, and none of the Western Hemisphere genera have been treated in a modern, revisionary context. Most descriptions of Western Hemisphere species are scattered throughout the literature, and illustrations of taxonomically important structures are the exception.

This study stems from an earlier investigation in which I attempted to elucidate taxonomic characters to differentiate larvae of a few species of hydraenids in southern California. Although I was able to rear larvae and therefore definitely associate the adult and larval forms of a species, it soon became apparent that taxonomic literature on the adults was quite inadequate. Consequently, although differentiating characters were found for the larvae, the taxa they represented remained problematic. This work will correct that situation, and, hopefully, provide a stimulus and stable basis for future studies on the immature stages.

The family Hydraenidae was first proposed by d'Orchymont (1919) based upon criteria he had presented previously (1916). These criteria included some considerations of both larval and adult structures, and resulted in the organization of the included taxa in three subfamilies: Hydraeninae, Limnebiinae, and Spercheinae. These three groups had originally been placed in the Hydrophilidae.

Twelve years later, Böving and Craighead (1931) published their extensive work on the larvae of Coleoptera, in which they concluded that the genera *Limnebius*, *Hydraena* and *Ochthebius* constituted a family in the "leptinid association" of the Staphylinoidea, and proposed the name Limnebiidae, whereas *Spercheus* was afforded familial rank within the Hydrophiloidea. Apparently Böving and Craighead were unaware of d'Orchymont's previous work.

Leech (1948) was the first American entomologist to point out that d'Orchymont's name Hydraenidae was published prior to Böving and Craighead's Limnebiidae; he also indicated that the name may be credited to Mulsant (1844). Leech (1948) states, "Judging from the recent work of students in other orders of insects, and their interpretation of the International Rules and of Opinion 133, the name Limnebiidae should be credited not to Böving but to Mulsant who proposed it as 'Limnebiaires' (1844: 88). On the other hand, the name Hydraenidae has been in use for many years by d'Orchymont, and perhaps should take precedence. It too may be credited to Mulsant (1844: 27), based on his 'Hydraenaires'."

Later, Leech (in Leech and Chandler, 1956) used the name Hydraenidae in his review of the United States genera and California species. Nevertheless, during the 1960's the incorrect

name Limnebiidae continued to appear in general works by American authors (e.g., Borror and DeLong, 1964; Arnett, 1968). More recent works by American authors (e.g., Doyen and Ulrich, 1978) use the name Hydraenidae, and the name has been in use by European authors since it was proposed by d'Orchymont (1919).

LIST OF ABBREVIATIONS

The following abbreviations in the text indicate collections from which material was borrowed and the repository of specimens.

AFN	A.F. Newton, Jr., Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts
AG	A. Gillogly, Fort Baker, California
AMNH	L.H. Herman, American Museum of Natural History, New York
ASP	Academy of Natural Sciences, Philadelphia
BMNH	P. Hammond, M.E. Bacchus, British Museum (Natural History), London
CAS	H.B. Leech, D.H. Kavanaugh, California Academy of Sciences, San Francisco
CCW	W.R. Suter, Carthage College, Wisconsin
CFMNH	H. Dybas, Field Museum of Natural History, Chicago
CMP	G. Wallace, Carnegie Museum, Pittsburgh
CNC	A. Smetana, Canadian National Collection, Ottawa
CSQ	R. Beique, Complexe scientifique du Québec
CU	L.L. Pechuman, Cornell University, New York
DCM	D.C. Miller, City College of New York
DPW	C.P. Wooldridge, Pennsylvania State University, University Park, Pennsylvania
EJK	E.J. Kiteley, Québec
FNY	F.N. Young, Univeristy of Indiana, Bloomington, Indiana
GWF	G.W. Folkerts, Auburn University, Auburn, Alabama
HM	H. Silfverberg, Helsinki Museum
HNHM	Z. Kaszab, Hungarian Natural History Museum, Budapest
HPB	Harley P. Brown, University of Oklahoma, Norman, Oklahoma
INHS	M.W. Sanderson, Illinois Natural History Survey
IOJ	T.H. Farr, Science Museum, Institute of Jamaica, Kingston
ISNB	E. Janssens, G. Demoulin, Institut royal des Sciences Naturelles de Belgique, Brussels
ISU	R.E. Lewis, Iowa State University, Ames, Iowa
JEC	J.E. Cronin, California
JFB	J.F. Brimley, Wellington, Ontario
JLC	J.L. Carr, Calgary, Alberta
JLH	J.L. Hellman, University of Maryland, College Park, Maryland
JS	J. Schuh Klamath Falls, Oregon
KS	Karl Stephan, Tucson, Arizona
LACM	C.L. Hogue, Los Angeles County Museum
LSU	J.B. Chapin, Louisiana State University, Baton Rouge, Louisiana
MCZ	J.Scott, A. Newton, M. Thayer, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts
MHNC	A. Camousseight, Museo Nacional de Historia Naturale, Santiago, Chile
MSP	Hans Reichardt, Cleide Costa, Museu de Zoologia da University de São Paulo
MU	V.R. Vickery, McGill University, Montreal, Quebec
NDSU	R.L. Post, A. Ashworth, North Dakota State University, Fargo, North Dakota
NMD	N.M. Downie, Lafayette, Indiana
NYSS	R.E. Kurczewski, State University of New York, Syracuse
ODA	R.L. Westcott, Oregon Department of Agriculture, Salem, Oregon
ORSU	L. Ryker, Oregon State University, Corvallis, Oregon
OSU	C.A. Triplehorn, Ohio State University, Columbus, Ohio
PBPI	K.R. Valley, Pennsylvania Bureau of Plant Industry
PDP	P.D. Perkins, National Museum of Natural History, Washington, D.C.
PM	J. Menier, Museum National d'Historie Naturelle, Paris, France
PMNH	K.W. Brown, Peabody Museum of Natural History, Connecticut
PU	A. Provonsha, Purdue University, Lafayette, Indiana

RG	R. Gordon, Washington, D.C.
RTA	R.T. Allen, University of Arkansas, Fayetteville
SC	St. Cloud State College, Minnesota
SDSU	E.U. Balsbaugh, Jr., South Dakota State University
SII	Staten Island Institute of Arts and Sciences, New York
UA	F.G. Werner, University of Arizona, Tucson, Arizona
UBC	K.M. Stuart, University of British Columbia, Vancouver
UCB	J.A. Chemsak, University of California, Berkeley
UCD	R.O. Schuster, University of California, Davis
UCR	S. Frommer, University of California, Riverside
UCM	U.N. Lanham, University of Colorado Museum, Boulder
UI	University of Idaho, Moscow, Idaho
UM	M. Coulloudon, University of Montreal, Montreal
UMA	P.J. Clausen, University of Minnesota, Minneapolis, Minnesota
UMI	T.E. Moore, University of Michigan, Ann Arbor, Michigan
UNH	University of New Hampshire, Durham, New Hampshire
USNM	P.J. Spangler, National Museum of Natural History, Washington, D.C.
UW	L.J. Bayer, University of Wisconsin, Madison, Wisconsin
UWA	S. Rohwer, University of Washington, Seattle, Washington
VMK	V.M. Kirk, South Dakota Insect Laboratory
WRS	Walter R. Suter, Carthage College, Wisconsin
WSUP	W.J. Turner, Washington State University, Pullman.

NATURAL HISTORY

Members of the family Hydraenidae in the Western Hemisphere are most frequently found at the margins of clear, sandy streams (Figs. 191A,192A). In such habitats they are easily collected by stirring the sand and gravel at the waterline and waiting for the beetles to float to the surface, where they remain suspended, upside-down, in the surface film. Since they cannot swim, these tiny beetles become trapped in the surface film, appearing as silvery specks due to their ventral air bubble. While in this inverted position, a beetle is able to walk about on the underside of the surface film, and when near an emergent object the floating beetle is immediately pulled to the object by surface tension, and rapidly crawls beneath the surface.

In streams of western North America one can frequently find *Hydraena*, *Ochthebius* and *Limnebius* adults in microsympatry with adults of such hydrophilid genera as *Laccobius* and *Chaetarthria*. Elsewhere (Perkins, 1976) I described a sampling technique which can be used to study the different microhabitat zones used by these psammophilous aquatic beetles, and factors which limit their microhabitat distributions. I refer the reader to that paper for details on this topic, and restrict my comments to more generalized aspects of habitat use by hydraenids.

Generally speaking, the adaptation of species to margins of lentic habitats, such as ponds, lakes and rock pools, sees its greatest expression in *Ochthebius* and allied genera, a decidedly smaller percentage of *Hydraena* species being typical of such habitats, whereas New World *Limnebius* species are known only from flowing water. *Ochthebius* is also the only genus of these three which has species adapted to margins of saline and alkaline aquatic habitats, such as salt marshes and mineralized hot springs.

Certain other genera are quite specialized in their use of aquatic habitats. *Neochthebius* adults are found only in cracks and crevices of intertidal rocks (Figs. 198A-C), whereas *Parhydraenida* adults are madicolous and *Spanglerina* adults live on plant debris trapped behind emergent rocks in rapid tropical streams (Figs. 196A,B).

Although members of Hydraenidae in the Western Hemisphere are less frequently collected than those of many other families of aquatic insects, they are extremely abundant locally if the physical conditions are appropriate (e.g., *Hydraena anisonycha*, *Ochthebius attritus*, *Limnebius ozapalachicus*, among others).

Where along a drainage system hydraenids live, and densities attained by the localized populations, are determined to a large extent by particle and interstitial space size of shoreline substrate; if particle size is too small, and consequently also interstitial space size, such as in muddy areas (or silty streams), hydraenids will usually not be present. Conversely, if the shoreline substrate consists of large stones and boulders, a few specimens of hydraenids may be found, but not dense populations (an exception to this statement are those species well adapted to lentic habitats, such as potholes, which can develop dense populations when conditions are favorable).

Population densities are also intimately related to slope and permanence of the stream bank (Perkins, 1976). Relatively permanent streambanks with well sorted particles provide living space and permanence necessary for larvae to complete their development. Larvae have thin cuticles, requiring that they be in moist situations. However, hydraenid larvae are not aquatic in the strict sense, and drown if kept beneath the water's surface for extended periods. Their small size makes even a drop of water potentially dangerous in the proper circumstances.

Slope of a streambank, its permanence, and degree of saturation of the psammic zone are all intimately related. Relatively saturated banks generally have a much lower slope angle and are much more frequently washed downstream and redeposited, whereas relatively unsaturated banks are generally much more permanent and have a higher slope angle. Frequent mixing of particles in the relatively saturated and impermanent banks results in more uniform particle size and prevents vertical sorting of particles. Relatively permanent banks, however, do not have the particles mixed frequently and the banks are high enough above the water level of the stream to allow percolation of rain water and water splashing from the stream, with the consequent sorting of particles (Perkins, 1976). Along streams and creeks with relatively permanent, sandy shorelines high population densities of hydraenids are usually encountered (again, these generalizations do not pertain to species typical of standing water).

My experiences collecting in Mexico and Central America revealed habitat preferences which were quite unexpected. Specimens of a few hydraenids, including all species of *Spanglerina*, were found almost exclusively on leaves and twigs which had become trapped behind stones in rapid tropical streams and cascades (Figs. 196A,B).

These tropical streams typically have a fast flow rate and lack relatively permanent sand-gravel banks of moderate slope angle and consisting of well sorted particles. Instead, these rapid tropical streams generally have large boulders behind which first limbs then leaves and twigs of the plentiful tropical vegetation become trapped.

Two species of *Hydraena* have also been found in these *Spanglerina* type habitats, *Hydraena cuspidicollis* and *Hydraena geminya*, as I have collected the former in association with *Spanglerina ingens* and the latter with *Spanglerina brevis* The common habitat of *Hydraena geminya* and *Spanglerina* perhaps explains the widely separated pro- and mesocoxae of adults of *Hydraena geminya* and of the other two species of *Hydraena* closely related to it (*geminya* Subgroup). One of the distinctive characteristics of *Spanglerina* adults is the widely spread coxae (Figs. 63A,65B) which, as in the Elmidae, are probably an adaptation to allow the beetles to cling tightly to leaves and twigs in habitats where water flows rapidly.

Data on the immature stages of Hydraenidae, other than that presented in the section on

phylogeny, will be published separately. More specific natural history data pertaining to adults, when available, is presented in the individual species sections.

CRITERIA FOR SPECIES LEVEL TAXA

The common notion of reproductive isolation is central to the biological species concept, which I accept (see Mayr, 1969). In practice, determination of reproductive isolation in most groups is based almost entirely upon indirect, anatomical evidence. Therefore, although it is possible to demonstrate reproductive isolation, in actuality it is inferred in most taxonomic work. However, anatomical features upon which inferences are based when predicting species limits differ markedly from those used in phylogeny reconstruction in that autapomorphous characters (unique to a species), which do not provide information for phylogeny reconstruction, are the primary basis for inferring reproductive isolation. Conversely, synapomorphic (see Hennig, 1966) anatomical features are most useful in phylogeny reconstruction, but of little aid when attempting to determine species limits.

In most insect groups, including the Hydraenidae, the taxonomist is provided with a powerful tool of species limits inference in the male genitalia. In Hydraenidae the aedeagus provides the single most dependable structure upon which to base species level inferences. Consequently, I have placed a great deal of emphasis upon this structure and am confident it justifies the "weighting" it has been given. I have made an attempt, when possible, to not only display the aedeagal differences between species, but also indicate infraspecific aedeagal variation (e.g., Figs. 91A-F,104,113A, etc.). After examination of the adeagus in excess of 5200 males, I am confident of the diagnostic importance of this structure. Other external characteristics are important and they have been carefully studied and described in detail. However, the most important features in determining closely related sister-species are provided by the aedeagus.

Because of the highly diagnostic nature of the male genitalia, I have refrained almost entirely from describing new species when males were not available. Thus, of the 142 new species described herein, only four of these are known at present from female specimens alone. These four species are very distinct externally and have been described because they contribute significantly to our knowledge of either generic distributions (*Meropathus vectis, Parhydraenida pentatenkta*) or species group phylogeny (*Gymnochthebius maureenae*, *Gymnochthebius perlabidus*). Additional species in the genera *Parhydraenida*, *Hydraena*, *Ochthebius* and *Gymnochthebius* are apparent in the material studied, but I prefer to await capture of males before describing these species.

For supraspecific categories, subgenera are recognized only for *Ochthebius* (see classification section for rationale). Other aggregates of species (below the generic level) are ranked in informal categories of "species group", "species subgroup" or "species complex". As is discussed in the classification sections on *Hydraena* and *Ochthebius*, subgeneric taxa recognized by earlier workers are generally found to be linked to one another by transitional stages, and hence, in this family at least, serve principally to burden the nomenclature.

METHODS AND MATERIALS

I have examined more than 21,250 adult New World hydraenids plus a significant number of specimens from other regions of the globe during this study (see Appendix B). Of the New World specimens, more than 5,218 males were dissected to remove the aedeagus, and numerous females were dissected to remove the spermatheca (see following section). To attach beetles to paper "points", I used common fingernail polish which dissolves with amyl acetate or fingernail polish remover. A "Wild M5" stereomicroscope was used throughout the study, and measurements were made with an ocular micrometer fitted to the microscope.

Dissecting techniques

The aedeagus of hydraenid beetles is best removed by opening the elytra and making an incision along one side in the tergal-sternal membrane from the fourth to the sixth segments, plus severing the intersegmental membranes between the third and fourth and between the sixth and seventh terga. The flap of terga thus formed is then laid back, exposing the abdominal contents, and the aedeagus is extracted with a fine probe. Once the aedeagus has been removed, the flap of terga is replaced and the elytra returned to the closed position.

For study of the gut and internal reproductive system, it is generally necessary to remove the elytra entirely, then make an incision along the length of the pleural membrane so that all of the terga may be lifted. The gut is severed where it enters the abdominal cavity, and the intersegmental membrane between the fifth and sixth sterna is ruptured, allowing the abdominal cavity contents to be removed intact.

Once removed, aedeagus and/or abdominal contents are transferred to glycerin from the water or alcohol in which the dissections were made. For adeagi dissected in alcohol, the transfer must be made very rapidly so that partial drying does not occur. Drying allows the formation of air pockets, which in turn obscure internal structure. Once the sclerites are in glycerin, this is no longer a problem because of the low evaporative rate.

For storage, aedeagi were placed in a tiny drop of glycerin inside a small glass vial which is cork stoppered. The vial is then affixed to the pin by inserting the pin through the cork, and the vial is oriented so that the aedeagus is visible through the upper surface of the vial when the beetle is being studied. Storage in a vial not only provides protection for the aedeagus, but also affords a degree of protection for the beetle since some of the glass vial projects slightly beyond the beetle.

I view the method used by d'Orchymont and some others of gluing the aedeagus by its base to the corner of the card upon which the beetle is also glued as improper since it places this singularly important structure in a very precarious position. Additionally, it allows the aedeagus to dry which makes it very brittle and further subject to damage.

Equally improper is the preparation of permanent slide mounts of aedeagi in this group. This treatment forces the apical portion to be twisted from its proper place in relation to surrounding surfaces, resulting also in distortion of the midregion. In addition, oval structures are flattened, the aedeagus is seen in only one view, and the microslide must be placed in a collection separate from the beetle, thereby increasing the probability of loss. The results of distortion by microslide mounting are apparent in the illustration of the aedeagus of *Hydraena insularis* d'Orchymont (Fig. 53D). *Ochthebius kaszabi* Janssens is an example of the problems that can develop when the holotype aedeagus is slide mounted.

Illustrations

All drawings were made by me. Aedeagi were drawn with the aid of a microprojector, which presents the specimen's exact image. Highly asymmetrical structures such as the aedeagi of hydraenids must be illustrated in two views to allow adequate conceptualization of contours. Consequently, all of the aedeagal illustrations were made in two views, one dorsal and one of the left lateral aspect. Additionally, partial drawings were made when slight rotation of the apical portion provides significant additional information.

The more complex aedeagi of *Hydraena*, and portions of aedeagi of other genera where contours are especially well developed and important, are stippled in an attempt to reveal these contours and internal structures.

All aedeagi are at the same scale to make comparison easy. Representative scale lines are given for most genera (Figs. 13,18,19,22,72,84,100,138,144). Likewise, all body outline illustrations, drawn with a camera lucida mounted to the microscope, are at the same scale.

Internal reproductive structures were also drawn with the aid of a microprojector.

MORPHOLOGICAL ANALYSIS

Certain morphological features of various genera in the family are worthy of special comparative discussion, which is presented here. Morphological features used in the taxonomic treatment are not treated in detail here, but are discussed and illustrated within each generic unit under the "Discussion" and "Pronotal features" sections.

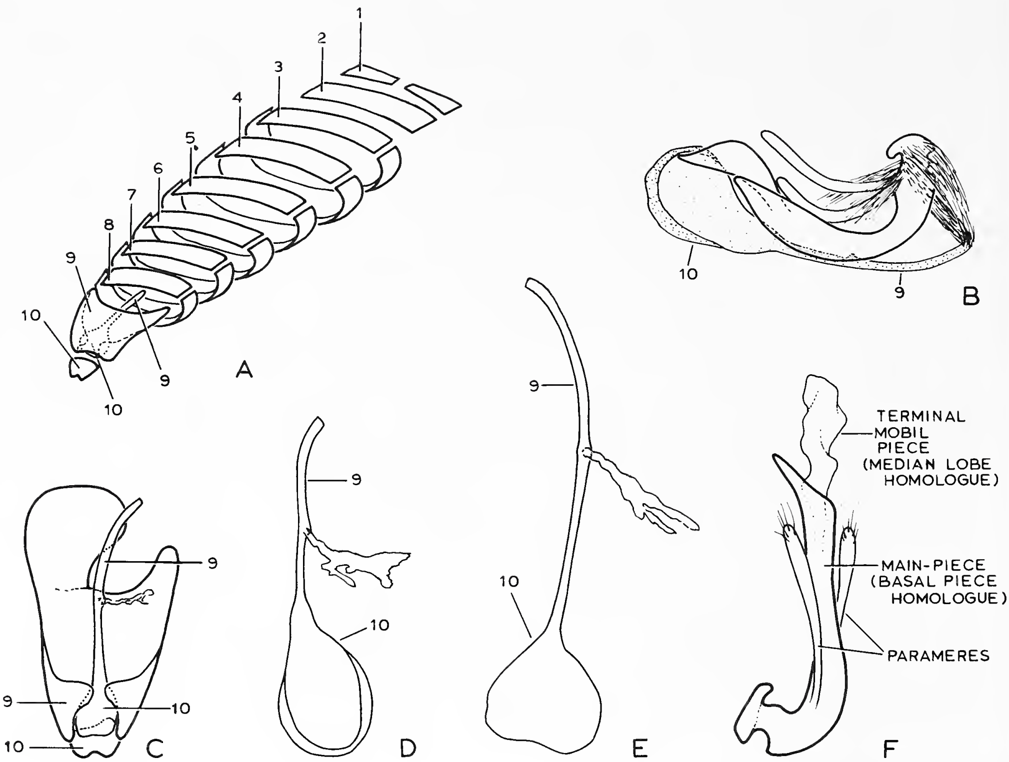
Sexual dimorphism

Sexual differences are expressed in several external morphological trends within the family. Because of the highly diagnostic nature of the male genitalia, these sexual differences assume a significant practical importance since they permit ready recognition of males.

The apex of the abdomen differs between sexes in all species: males with the last sternum narrower and the penultimate tergum "wrapped around" the sides of the abdomen so that this tergum is readily visible from ventral view (Figs. 3A,B,63D); females have the last sternum broader and the penultimate tergum not wrapped around to the extent seen in males (Figs. 3D,35C). In addition, males of certain species have the last abdominal segments elongate, this applies primarily to species of the *leechi* and *marginicollis* Groups of *Hydraena* (Figs. 54B,63B). However, since males of many species do not have elongate segments, and because the last sternum and part of the last tergum are concealed in some individuals due to contraction (Figs. 63A,C), it is convenient to have recourse to other sexual differentiating structures.

Females of *Hydraena* and *Spanglerina* have a row of long setae across the anterior portion of the fifth abdominal sternum (Figs. 35C,48B); this fringe probably functions to prevent collapse of the ventral air bubble during oviposition. Males have sparse, random, shorter setae on this sternum (Figs. 63A-D).

Males of many species of *Hydraena* and *Spanglerina* (but not including the *circulata* Group of *Hydraena* other than *Hydraena quadricurvipes*), have distinctive modifications of the pro- and metatibiae which take a great many forms, some of which are species specific. Protibiae are excavated near the apex (Figs. 54G,H) or are swollen in many shapes on the inner surface (Figs. 61C,D,G,H). The metatibiae of some males are enlarged



Figs. 2A – F (A) diagrammatic representation of abdominal sclerites of *Hydraena d-destina* ♂. (B) aedeagus, homologues of sterna 9 and 10 and associated muscles of *Ochthebius puncticollis*. (C) ventral view of terga 9 and 10 (numbered to left) and sterna (numbered to right) of *Hydraena anisonycha*. (D) sterna 9 and 10 and associated membrane of *Ochthebius puncticollis*. (E) as above, *Hydraena anisonycha*. (F) hypothetical hydraenid aedeagus.

(Figs. 32D-G,57C,E,F,61A,B,E,F), or have distinctive "brushes" of setae which are stiff and therefore do not lie flat against the leg in dry specimens (Figs. 32D-G). The extensive variation in form of the metatibiae suggests a high mutation rate for genes controlling this structure. Indeed, the only obvious deformity I have seen in the many specimens of *Hydraena* studied was a bifurcate metatibia in *Hydraena pontequula* (Fig. 63D).

Among the more unusual sexual differences in *Hydraena* are the highly asymmetrical middle claws of *Hydraena anisonycha* males (Fig. 57D) and the stridulatory ridges on the occiptial area of the head in males of the *leechi* Group (Fig. 31D) (discussed in a later section).

In sharp contrast to *Hydraena*, males of *Ochthebius*, *Gymnochthebius* and related genera do not display obvious differences in tibiae between sexes and females do not have the distinctive row of long setae on the fifth abdominal sternum. Instead, males of *Ochthebius* generally (but not invariably) have distinctive suction setae on protarsal segments (Figs. 98C,128E). Additionally, males of many species of *Ochthebius* and *Gymnochthebius* have the anterior margin of the labrum upturned and emarginate. Within the emargination are sensilla of various shapes, generally trumpet-shaped or spatuliform (Figs. 98B,D,103F,111A,115B,128D,F). Females also have these sensilla, but they are less developed and the labral margins are not

upturned at all or to the extent seen in males. The greater development of these sensilla in males (plus upturned margin which would presumably allow them to be placed closer to the object sensed) suggest that they may, at least in part, serve for mate recognition.

Males of *Gymnochthebius* species have two distinctive, longitudinal rows of setae on the last abdominal sternum.

Males of many *Meropathus* species have the labrum extended anteriorly into two remarkably long processes (e.g., *M. campbellensis*). The only Western Hemisphere species (*M. vectis*) is known only from females, but males are expected to possess these processes.

Hydraenida males are easily recognized by large pads of protarsal suction setae. *Parhydraenida* males, however, lack these pads of suction setae, but many have the labrum strongly upturned (Figs. 15B-D) and the abdominal differences between sexes described above generally are obvious.

Limnebius males are easily differentiated, possessing large pads of suction setae on the pro- and mesotarsi (Fig. 69C). Additionally, males generally have the elytral apices truncate slightly, and frequently have a median oval depression on the sixth abdominal sternum.

Aedeagus

In most species of hydraenids the aedeagus is a tubular structure, more or less curved at the base and has two lateral parameres (Figs. 2F,22A-E,60A-D). It differs from the typical four lobed (basal piece + median lobe + two parameres) aedeagus of most polyphagan males in that it lacks (in many species) an obvious, distinct demarcation between basal piece and median lobe.

Lack of a distinctive demarcation between basal piece and median lobe has prompted some authors to postulate that the basal piece, as such, is absent from Hydraenidae, and therefore the entire aedeagus, with the exception of the parameres, consists of a structure homologous to the median lobe of other beetles. Thus, Crowson (1955) states, "Not the least remarkable feature of these perplexing insects is their abdominal structure. Assuming that, as is general in Haplogastran beetles, the first complete visible sternite belongs to the third abdominal segment and that the second is represented only by lateral pleural vestiges and perhaps some trace in the middle between the hind coxae, the adult in both sexes would appear to have complete tergites and sternites up to and including the ninth segment and a distinct tergite for the tenth. The presence of a distinct ninth sternite seems here, as in the Staphylinidae, to be correlated with the absence of a basal piece of the aedeagus; in fact it seems quite possible that the basal piece of the aedeagus is the ninth sternite".

Specialists in the Hydraenidae, however, have contended that the main tūbe of the aedeagus actually represents the basal piece and that the structure at the apex of this heavily sclerotized tube is homologous to the median lobe of the plesiomorphic state. This terminal structure is frequently movable (mobile) and structurally very complex. D'Orchymont (1929c) was apparently the first to present this view, as he compared the hydraenid aedeagus to that of the hydrophilid, *Spercheus*: "Il se compose d'une partie rigide et fortemont sclerifiee en form de coin, de forme trés variée, ordinairement en courbe plus or moins prononcée dont la concavité es dorsale. C'est l'equivalent du lobe basal des *Spercheus* et des Hydrophilidae (*sensu stricto*); de a lobe basal á une certain distance de sa base et avant son extreémité se détache á droite un lobe médian....".

F. Balfour-Browne (1958: 45), after mentioning the comments of d'Orchymont, states, "My son has come to the same conclusion, that the main-piece is the basal piece and in this I agree".

It is also possible that the basal piece and median lobe have fused. If so, the major portion of the main-piece could be homologous to the median lobe, and perhaps the terminal or pre-terminal process of hydraenid aedeagi is homologous to the internal sac of staphylinoids. This interpretation has its problems, however. For instance, in *Limnebius* (Figs. 70,71) the enlarged base has an internal, coiled duct. In addition, the aedeagus has a well developed, articulated terminal process. If the terminal process is considered the internal sac homologue, then what is the homology of the coiled duct? If however the coiled duct is considered the internal sac homologue, then the terminal process could be considered the median lobe homologue, and the basal portion becomes homologous to the basal piece.

Returning to Crowson's (1955) suggestion that the basal piece of hydraenids has become the ninth sternum, I must disagree with this notion since, as is explained further in the following section on the abdomen, it appears to me that the last abdominal sternum is actually the tenth, whereas the ninth sternum has become the rod-like, internal strut (Figs. 2A-E) which is attached to this last sternum. In many males there is a small swelling near the midregion of this strut, and a minute fragment of membrane attached at this swelling; these possibly represent the vestiges of the intersegmental membrane which separated the ancestral ninth and tenth sterna.

Further, large, short muscles join the end of the strut to the base of the aedeagus (Fig. 2B). If the strut actually represented the basal piece, these strong muscles would therefore be between the basal piece and the median lobe, a highly unlikely arrangement.

These strong, short muscles connecting the end of the strut and the base of the aedeagus present an interesting problem, since they are obviously too short to permit protrusion of the aedeagus beyond the abdominal apex during copulation. Another group of muscles also attach at the base of the aedeagus, but these muscles are long and originate on the ninth tergum, and presumably are those which function to extend the aedeagus. One explanation to resolve this problem is that the slender strut is flexible and bends to permit extrusion of the aedeagus, then provides the force, due to its elasticity, to return the aedeagus to its position in the abdomen when the long muscles relax following copulation.

If one looks closely at the short muscles connecting the strut and the aedeagal base (Fig. 2B), they are seen to be attached to the aedeagus in two groups, one on each side of the base. Contraction of these muscles, therefore, would not only cause the aedeagus to be very slightly drawn closer to the end of the strut, but would also cause extensive rotation of the aedeagus.

How do these muscles function? I have observed *Hydraena marginicollis* adults during copulation, and have seen the following sequence in aedeagal extension: 1) the aedeagus extends in a straight line posteriorly out of the abdomen, until all, or nearly all, of the aedeagus (except the curved basal portion) is outside the abdomen; 2) the aedeagus tilts upward so that its apex is pointed dorsally: 3) the aedeagus swings to the left side of the beetle and continues this arc until it is directly beneath the midline of the abdomen, in the copulatory position. This sequence of events is followed in reverse during retraction of the aedeagus, but differs in that retraction is generally more rapid than extension.

Apparently the muscles and strut function in the following manner: 1) at rest in the abdomen, the aedeagus is dorsal to the strut, with the curved basal portion (and therefore the basal opening of the aedeagus) directed dorsally (tilted to the side slightly in some species); 2) the long muscles connecting the aedeagal base and ninth tergum contract, causing the aedeagus to emerge from the abdomen on a straight line until the curved base reaches the abdominal

apex, and also causing the strut to bend; 3) further contraction of the long muscles cause the aedeagus to tilt upward so that it points dorsally; 4) one of the two muscle bundles joining the aedeagus and strut contracts, causing the aedeagus to swing to the side and then ventrally to the horizontal, copulatory position; 5) following copulation, contraction of the other of the two short muscle bundles (and concurrent relaxation of the first) connecting the aedeagal base and the strut returns the aedeagus to the vertical position; and 6) the long muscles relax, permitting elasticity of the strut to return the aedeagus to the horizontal resting position within the abdomen.

In *Hydraena marginicollis* males the slender tube at the apex of the aedeagus (Fig. 55A) is inserted into the female and the small, slightly elastic globose portion at the base of the slender tube comes in contact with the tenth tergum of the female. After insertion of the slender tube, the male pulsates the aedeagus against the female at a frequency of about two pulsations per second. It seems likely that this pulsation might cause the bulb at the base of the slender tube to act as a pump mechanism in sperm transfer. Such a bulb is seen in several species of *Hydraena*: *Hydraena pontequula* (Fig. 60D); *Hydraena guatemala*, (Fig. 51A); *Hydraena browni*, (Fig. 53A); *Hydraena pulsatrix*, (Fig. 55C); etc.

I have observed copulation in a number of *Hydraena* species, and suspect that parthenogenesis is quite rare in the family, if it exists at all. F. Balfour-Browne (1958), based upon the bizarre appearance of some hydraenid aedeagi, concluded that parthenogenesis was widespread in the family, stating (p. 149), "These *Hydraena*–group beetles, of which some or many may still be capable of mating, are in the early stage of a process which has gone much farther in the sawflies, but my son argues against there being any parthenogenesis among them and relies upon his work with some of the species in aquaria where he was unable to obtain eggs until he introduced males. He does not, however, claim to have seen the mating and he does not attempt to explain how the deformed aedeagus of many of the species can make the contact with the female", and regarding the four species of British *Limnebius* (p. 132), "To suggest that this type of armature is functional is stretching the imagination too far (reference is to *truncatellus* and *papposus*). Even in *nitidus*, in which the aedeagophore can still be recognized as trilobed, the aedeagus has such an elaborate expansion at or near the apex that it also is probably ornamental and otherwise functionless and I regard all our species as parthenogenetic".

Ratios of male/female specimens generally are indicative of bisexual reproduction (see Appendix A for figures). Two exceptions might be *Spanglerina brevis* and *Hydraena puncticollis*, both of which have very low male/female ratios which might be interpreted as reflecting facultative parthenogenesis. At one locality in Guatemala, near La Tinta (see Spangler and Perkins, 1977, figure 20), my wife and I collected 85 specimens of *S. brevis*, all female. There were also numerous larvae present, indicating excellent biotic potential for the site. However, the male/female ratio for a locality in Oaxaca, Mexico (see Spangler and Perkins, 1977, figure 19) approximated that seen in other species. *Hydraena puncticollis*, and what appear to be a few closely related, undescribed species, are only represented in collections by female specimens. Further field study is needed to determine the causes of low, sporadic male/female ratios in these species.

Males of some species appear to have developed an internal, sclerotized, protrusible tube which possibly is the primary intromissive portion of the aedeagus. *Gymnochthebius* males have an obvious internal sclerotized tube (Figs. 84A-D,88C) which differs in shape from species to species. I have seen one specimen which has this tube extended (Fig. 85D) and suspect that

males of most other species have the ability to extend this tube during copulation (see discussion section of *Gymnochthebius* for additional comments). Likewise, *Limnebius* males (Figs. 70A,71A,75D) have an internal tube, but it is much different than *Gymnochthebius*, being coiled in the globose base of the aedeagus. As in *Gymnochthebius*, I have seen only a single specimen with the tube extended, but suspect it is extended in all species during copulation.

Males of certain species of *Hydraena*, such as *H. prieto* (Fig. 47A) and *H. punctata* (Fig. 44B) have a slender, weakly sclerotized flagellum attached to the terminal portion of the aedeagus, but it is not known if these structures are retractile. Indeed, the supposition that the gonopore is located at the apex of these flagella requires verification.

Intraspecific variation in shape of the aedeagus is generally quite slight compared to interspecific differences . I have illustrated aedeagal morphs where they are significant (*Ochthebius lineatus*, Figs. 104,108C,D; *Ochthebius discretus*, Fig. 134A; *Gymnochthebius fossatus* Figs. 91A-F; etc.). Convergence in shape of the aedeagal "terminal piece" (see below), which is generally the most species-specific diagnostic portion of the structure, between distantly related species occurs very infrequently, an example being *Ochthebius batesoni* and *Neochthebius vandykei* (Figs. 143D,146D).

Concerning convergences, one development, loss of parameres, is a commonly derived condition, appearing in every major phylogenetic lineage within the family (see phylogram, Fig. 147). Hence, parameres are absent from males of Limnebius (Bilimneus) *Hydraena* (*Haenydra*), and *Meropathus*. Likewise, J. Balfour-Browne (1976) reported that a species within the *Ochthebius (sensu stricto)* lineage (as used herein) also is devoid of parameres.

Partial loss of parameres within certain lineages raises the question of mode of reduction of these structures. In most species of New World *Limnebius* the aedeagus has setose enlargements or patches of setae which probably represent the vestiges of parameres (Figs. 70A,71A), but these vestiges are located toward the distal end of the "main-piece" (see below), not near the base, the point of paramere insertion for those aedeagi with well developed parameres (Fig. 22A).

Likewise, parameres of *Hydraena paeminosa* males (Fig. 95D) have setose swellings near the apex of the main-piece, obviously derived from parameres.

Similarly, the aedeagi of *Parhydraenida* males (Figs. 18A-D) have a very small left paramere and a spike-like process (which I regard as the remnant of the right paramere – see discussion section of that genus), both of which are located near the apex of the main-piece, not attached to the base as in the closely related *Hydraenida*.

How, then, is paramere loss accomplished, and is the method of reduction the same in the diverse genera in which this trend is expressed? Two obvious possible modes of reduction come to mind: 1) loss of the parameres due to reduction in size or the more immediate loss due to one-step mutation; and 2) gradual fusion of the parameres to the main-piece.

The first explanation appears to apply to *Hydraena (Haenydra)* species, *Ochthebius lindbergi* J. Balfour-Browne (1976; mentioned above), and *Meropathus* species as males of these groups have a relatively slender main-piece (no indications of paramere fusion or remnants of setae) and generally have a small swelling at the base of the aedeagus where parameres generally originate in other species.

The second explanation, fusion of parameres to the main-piece, might be attributed to those species of *Limnebius* whose males have remnants of lobes and patches of setae near the distal end of the main-piece, the latter being relatively thickened. This mode might also apply to

Parhydraenida, where there is a strong indication of paramere reduction on one side, with the other paramere showing various degrees of reduction (*Parhydraenida paralonga*, Fig. 20A; *Parhydraenida reichardti*, Fig. 18A; and *Parhydraenida lambda*, Fig. 18D).

Another explanation might be advanced which relates to the question of the derivation of the main-piece which was discussed above, i.e., whether this part of the aedeagus is the homologue of the basal piece or median lobe of other beetles. If one accepts the theory supported above, as do I, that the main-piece is derived from the basal piece, then it can be supposed that a lengthening of the ancestral basal piece was necessary to form the heavily sclerotized, relatively long tube now seen in hydraenids. Therefore, it is possible that in certain lineages the basal piece elongated *distal* to the insertion of the parameres, resulting in the parameres being attached closer to the base of the aedeagus, whereas in other lineages the basal piece might have elongated *proximal* to the insertion of the parameres, resulting in parameres attached near the distal end of the sclerotized tube.

Such evolution of the basal piece might also explain the differences in basic plan of *Gymnochthebius* and *Ochthebius*, as the basal piece in males of the former surrounds the internal sclerotized tube (presumed homologue of the median lobe) (Fig. 84A), whereas in *Ochthebius* males the median lobe (terminal mobile piece) is outside the basal piece and attached subapically (Fig. 100A).

One cannot deny the great plasticity of the aedeagus in this family, as the illustrations herein attest. Because of this great variation, I have generally deferred to more descriptive terminology in reference to the aedeagus, as the hydraenid homologue of the "median lobe" is generally not median, and the "basal piece" is usually the major portion of the aedeagus (Fig. 2F). Instead, I have generally used "main-piece" for the basal piece homologue and "terminal mobile piece" or "terminal piece" for the median lobe homologue (or, as in the case of *Gymnochthebius*, the median lobe homologue is termed the "internal tube").

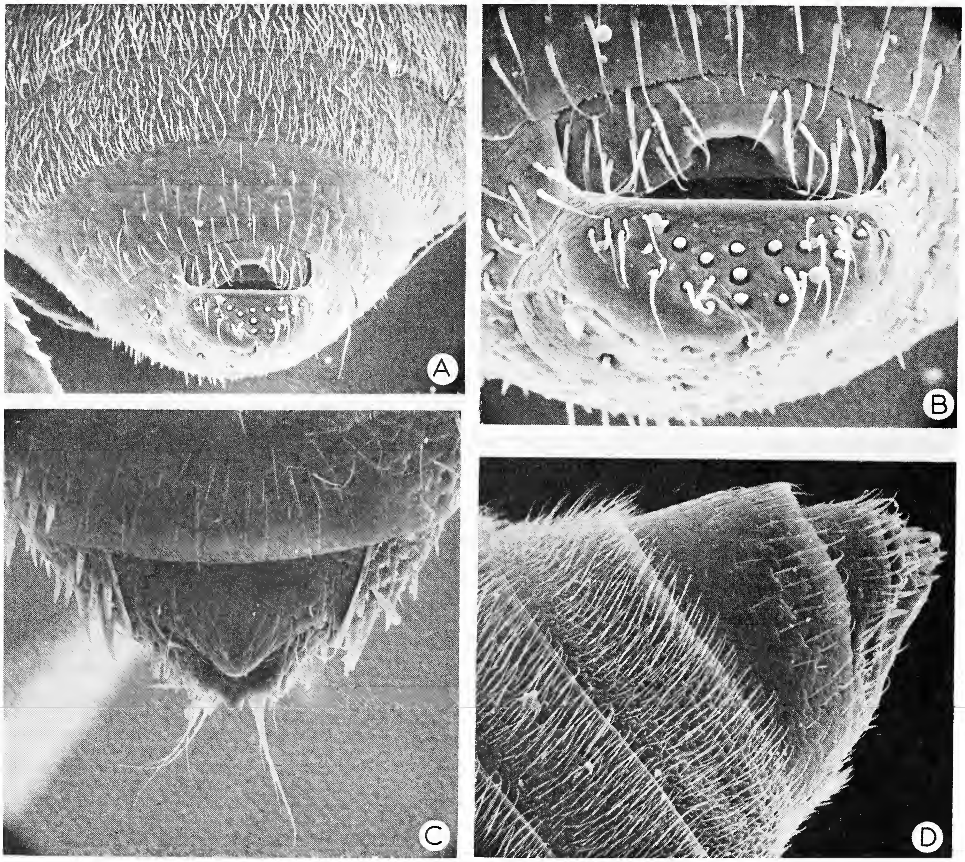
Abdomen

The abdomen in hydraenids is unusual in a number of respects. First and second terga are without corresponding sterna (the first tergum is incomplete, represented by two divided, sclerotized plates). The third tergum, however, does have a sternal counterpart so I assume that the first complete sternum actually represents the third abdominal segment. Adults of most genera have a small sclerite between the hind coxae (Fig. 21D) which must be derived from the second abdominal segment (this sclerite is referred to herein as the "intercoxal sternum").

Counting from the first tergum, therefore, abdominal segments 3-8 are complete and unambiguous. The sternal counterparts of terga 9 and 10, however, provide a source of controversy since there is only one obvious sternum which can be associated with the two terga (Fig. 2A).

As discussed earlier, Crowson (1955) suggested that this small, last sternum was derived from the ancestral basal piece of the aedeagus. In the previous section on the aedeagus I have presented my reasons for considering the aedeagus of hydraenids as possessing a basal piece, therefore, the nature of the last sternum must be explained differently.

This last sternum is unusual in that in males it is prolonged anteriorly into a thin, rod-like strut (Figs. 2A-E) in the abdomen, joined to the aedeagus by muscles (see previous section). This strut frequently has a small enlargement near midlength to which attaches a small fragment of tissue which could be the vestige of the intersegmental membrane separating the ancestral ninth and tenth sterna. I propose, therefore, that the rod-like strut is the modified



Figs. 3A – D, Abdominal apex. (A) *Ochthebius tubus*,♂. (B) As above. (C) *Limnebius sinuatus*, ♂ (D) *Ochthebius tubus*, ♀.

ancestral ninth sternum and the last sternum present today is the counterpart of the last tergum, that is, the tenth.

The manner in which the ninth tergum "wraps around" the abdomen (Figs. 2C,3A,B) in hydraenid males seems to support this hypothesis since its enlargement ventrally would presumably be associated with an equal reduction in size of the ninth sternum.

In males of hydraenids, the "wrapped around" portions of the ninth tergum are more developed than in females and in some groups this apparatus is withdrawn into the abdomen, being concealed by the sixth visible (true eighth) sternum. Consequently, in these groups inspection of the ventral surface reveals only six sterna. In other groups, especially those such as the *marginicollis* Group of *Hydraena* in which males have the apical (especially ninth tergite) segments elongate, the "wrapped around" portion of the ninth tergum plus the last sternum are clearly visible. Hence, in these groups inspection of the ventral surface reveals seven sterna (Figs. 63A-D).

In females the "wrapped around" portion of the ninth tergum is much less developed and the last sternum is larger than in males and is exposed. Hence, females always have seven

visible abdominal sterna (Figs. 35C,48B).

In the species descriptions that follow, sterna are referred to in an anatomical sense, numbering them beginning with the first complete sternum visible (visible #1, true #3) and ending with the last visible sternum (visible #7, true #10).

Internal Reproductive System

The male reproductive system of hydraenids (Fig. 4A), which has not been previously described, consists of paired testes, vasa deferentia, lateral accessory glands, median accessory gland, ejaculatory duct, and aedeagus.

Each testis is a single mass (Figs. 4D,8A) or two separate masses (Figs. 4B,5A,6C). Differentiation of sperm tubes is (Figs. 7C,8C) or is not apparent.

Ochthebius and *Gymnochthebius* males differ from one another in that males of *Gymnochthebius* (Figs. 4A,B,D,) have a distinct, globose posterior enlargement of the median accessory gland and the lateral accessory glands are globose also, whereas males of *Ochthebius* (Figs. 5,6A,B) lack a posterior enlargement of the median accessory gland and the lateral accessory glands are generally tubular. In addition, most *Ochthebius* males have the proximal end of the vas deferens enlarged which, presumably, serves as a sperm storage area, whereas in the *Gymnochthebius* males studied, the vas deferens is not enlarged at the proximal end, but empties into the globose anterior enlargement of the median accessory gland where sperm storage probably occurs. The anterior enlargement of the median accessory gland in *Ochthebius* assumes remarkable size in some males (*O. tubus*, Figs. 6A,B).

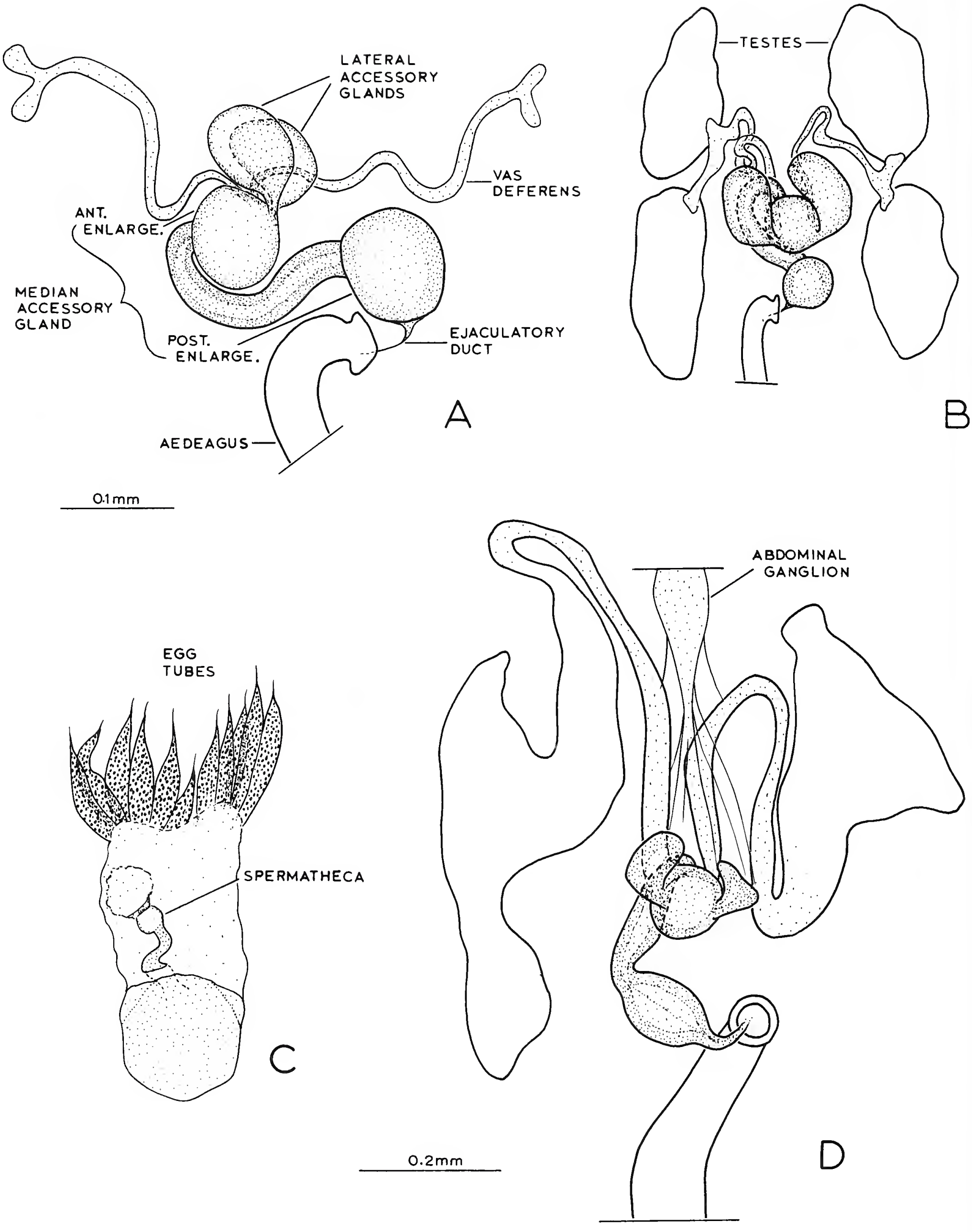
Within *Ochthebius*, I have studied only a single member of the subgenus *Asiobates* (*O. discretus*, Fig. 5A), which appears to differ from the nominal subgenus in that the proximal ends of the vas deferens are not enlarged and the median accessory gland is completely tubular, lacking an anterior enlargement (males of *Ochthebius (sensu stricto)* studied include *O. lineatus* of the *interruptus* Group, Fig. 5C; *O. californicus* of the *bisinuatus* Group, Fig. 5D; *O. gruwelli* and *O. tubus* of the *biincisus* Group, Figs. 5B,6A,B).

In *Hydraena* males, the median accessory gland and lateral accessory glands differ markedly among species groups. The median accessory gland has an anterior enlargement, but form of the enlargement and manner in which the enlargement and lateral accessory glands are joined varies. Unlike *Ochthebius* males, where the anterior enlargement appears simply a continuation of the median accessory gland, in *Hydraena* males the anterior enlargement, although generally small, appears more as an entity distinct from the median accessory gland, which generally joins its anterior enlargement at the same location as does the common duct of the lateral accessory glands (Figs. 7A,C).

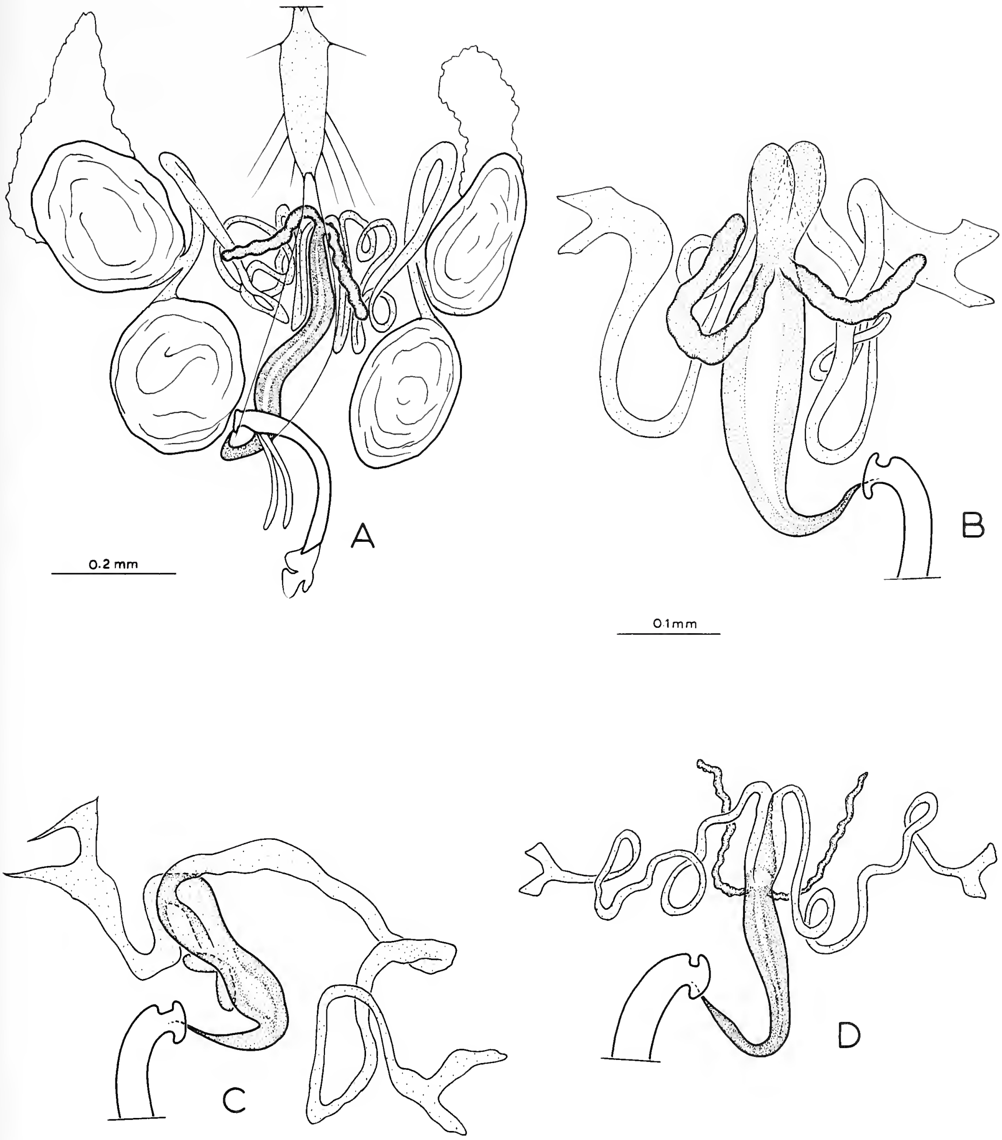
In males of *Hydraena anisonycha* (Fig. 8D), the major glandular region of the median accessory gland is situated more toward the proximal end, whereas the anterior enlargement is relatively small. Males of this species are unique among those studied in possession of distinct lacunae formed by a tight loop of the vas deferens.

Hydraena d-destina males (Fig. 8C), by contrast, have the anterior enlargement of the median accessory gland very large and quite complex, with the lateral accessory glands adpressed to its surface, the entire complex mass being topped by a twisted portion of the median accessory gland. Males of this species are also unusual in form of the sperm tubes, which are frequently coiled into flat discs.

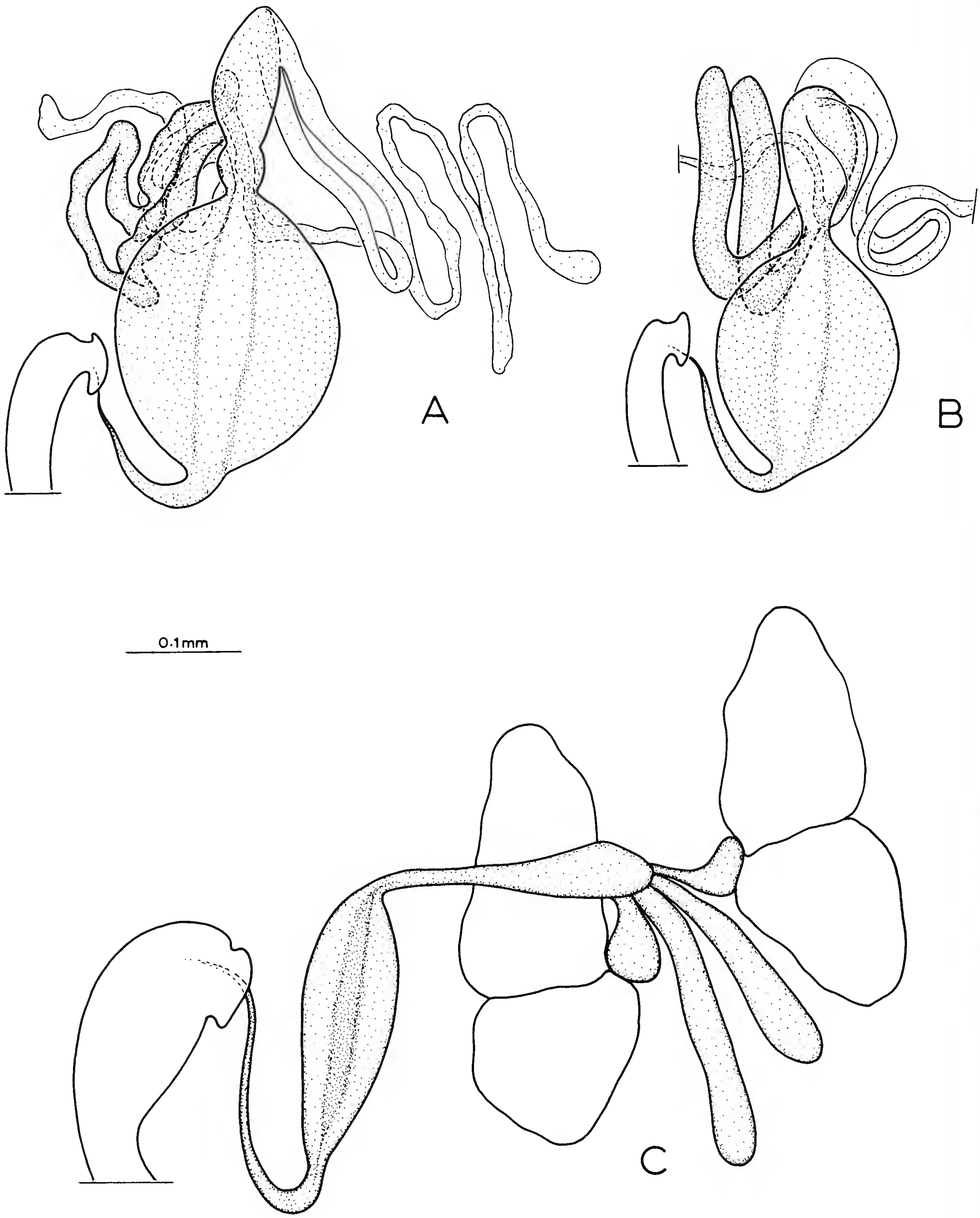
In *Hydraena bituberculata* males, (Fig. 8A) the anterior enlargement of the median accessory gland is well developed, as are the lateral accessory glands.



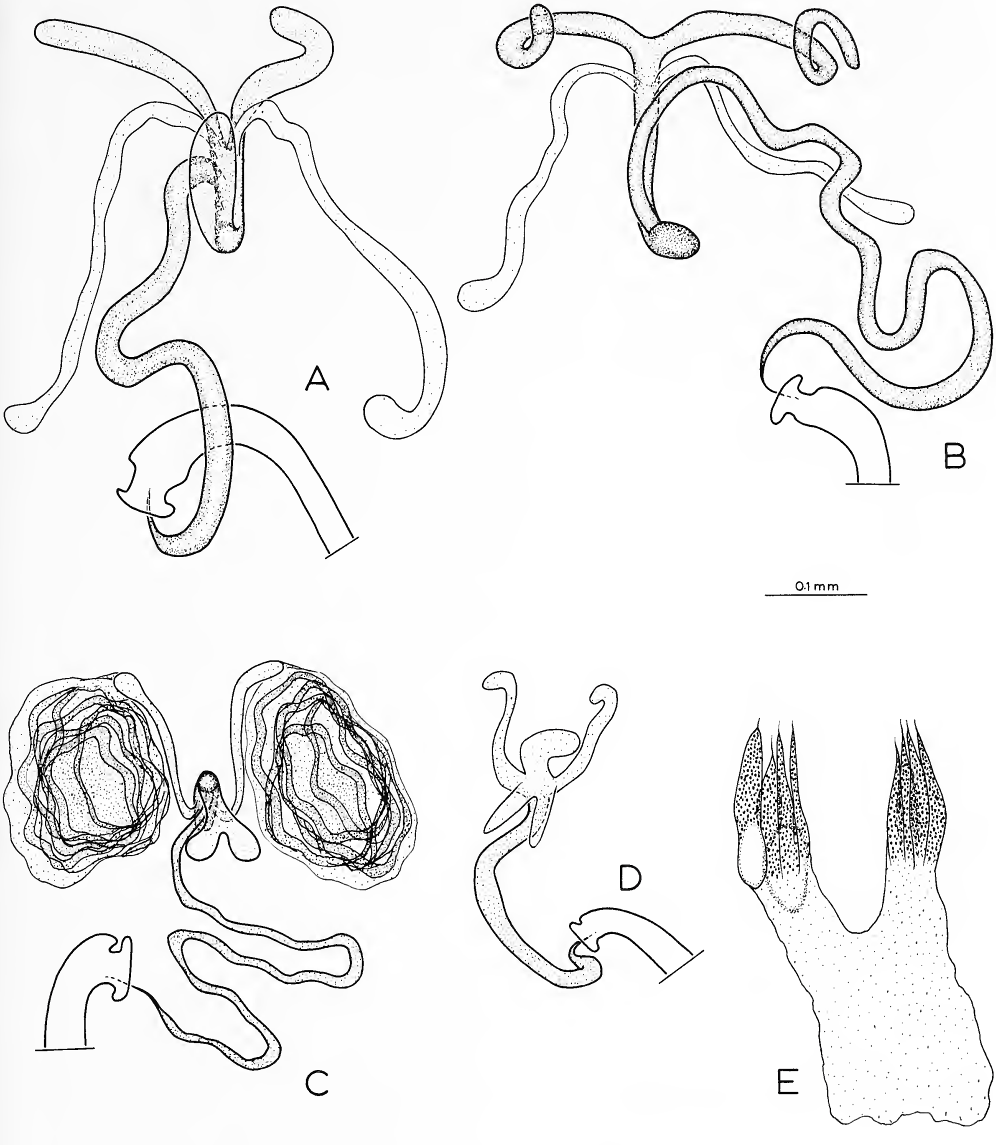
Figs. 4A – D, Internal reproductive structures. (A) *Gymnochthebius nitidus*, ♂ (testes omitted). (B) *G. fossatus*, ♂. (C) *G. nitidus*, ♀. (D) *G. clandestinus*, ♂ (plus abdominal ganglion). (B-D at same scale).



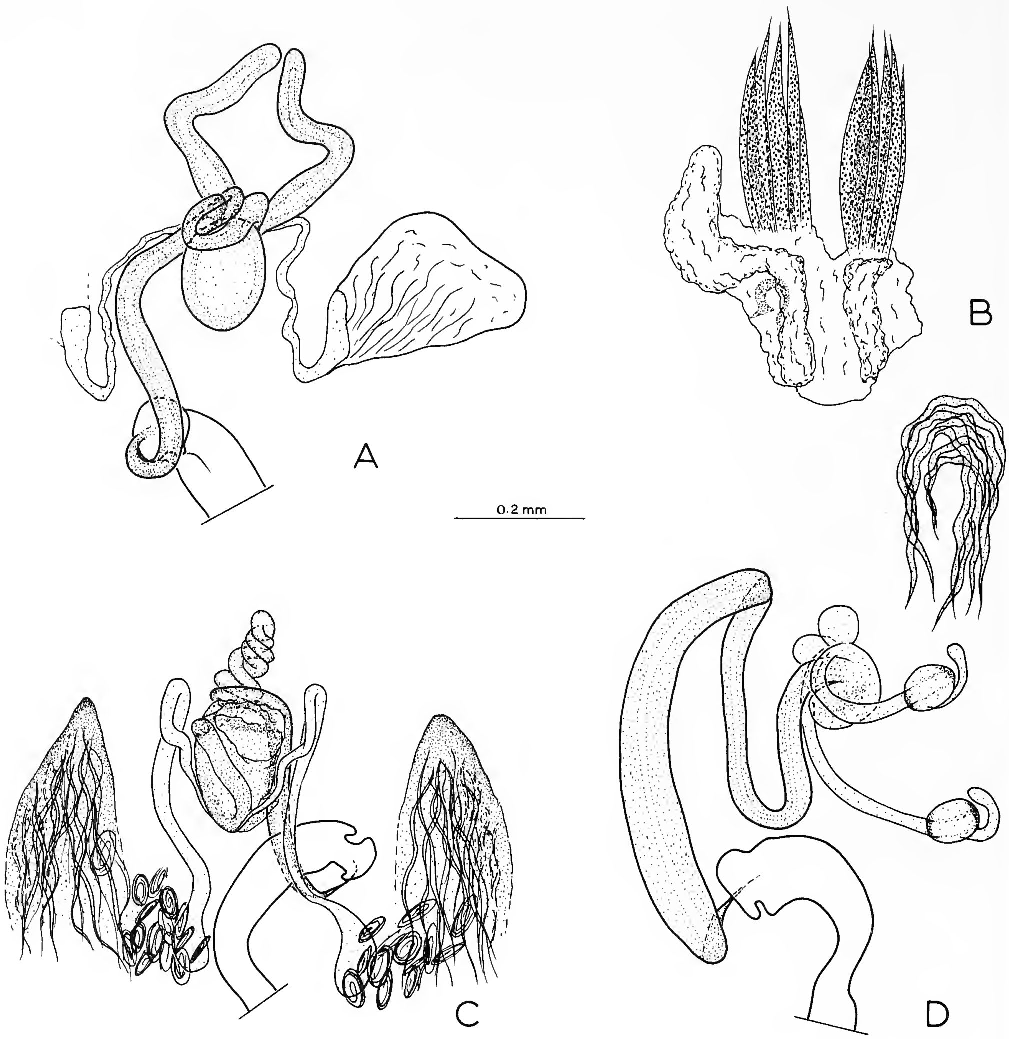
Figs. 5A – D, Male internal reproductive structures. (A) *Ochthebius discretus*. (B) *O. gruwelli*. (C) *O. lineatus*. (D) *O. californicus*. (testes omitted from B, C and D).



Figs. 6A – C, Male internal reproductive structures. (A) *Ochthebius tubus*, specimen from Monterey County, California. (B) *O. tubus*, specimen from San Luis Potosi, Mexico. (C) *Limnebius sinuatus*.



Figs. 7A – E, Internal reproductive structures. (A) *Hydraena atlantica*, ♂. (B) *H. circulata* ♂ (C) *H. marginicollis*, ♂. (D) *H. spangleri* ♂. (E) *H. spangleri*, ♀. (testes omitted from A, B and D).



Figs. 8A – D, Internal reproductive structures. (A) *Hydraena bituberculata*, ♂. (B) *H. atlantica*, ♀. (C) *H. d-destina*, ♂. (D) *H. anisonycha*, ♂ (part of testis illustrated).

In males of *Hydraena atlantica* and *Hydraena circulata* (Figs. 7A,B) the anterior enlargement of the median accessory gland is weakly to moderately developed, the lateral accessory glands being well developed and united to the anterior enlargement by a common duct.

The reproductive system of *Limnebius sinuatus* (Sharp) males (Fig. 6C) is relatively simple, but differs from the others mentioned in that the vas deferens are quite short and the median accessory gland is rather elongate, having a distinct, slightly expanded portion between the highly glandular anterior enlargement and the vas deferens. The lateral accessory glands are well developed.

Preliminary study suggests that at least some differences are detectable in the male reproductive system of closely related species. These differences relate to shape of the anterior enlargement and manner in which the vas deferens and lateral accessory glands join this enlargement. Thus, in *Hydraena circulata* and *Hydraena atlantica* males, differences in this region illustrated (Figs. 7A,B) are constant in the few specimens of each species studied. Differences in shape of the lateral accessory glands illustrated, however, are not constant, as males of *Hydraena atlantica* with curled apical portions of the lateral accessory glands have been seen. Differences are also evident between the two males of *Ochthebius tubus* illustrated (Figs. 6A,B). These may, in fact, represent two species, as the form from Mexico (Fig. 6B) differs also in aedeagal structure (see Fig. 124C) from the California form (Figs. 6A,124D). Further study is needed to determine reliability of internal reproductive structures as indicators of specific distinction.

The female reproductive system (Figs. 4C,8B,9,10) consists of ovaries (4–6 egg tubes), bursa copulatrix, spermatheca, spermathecal accessory gland and spermathecal duct. Also illustrated (Fig. 8B) are the presumed silk producing glands.

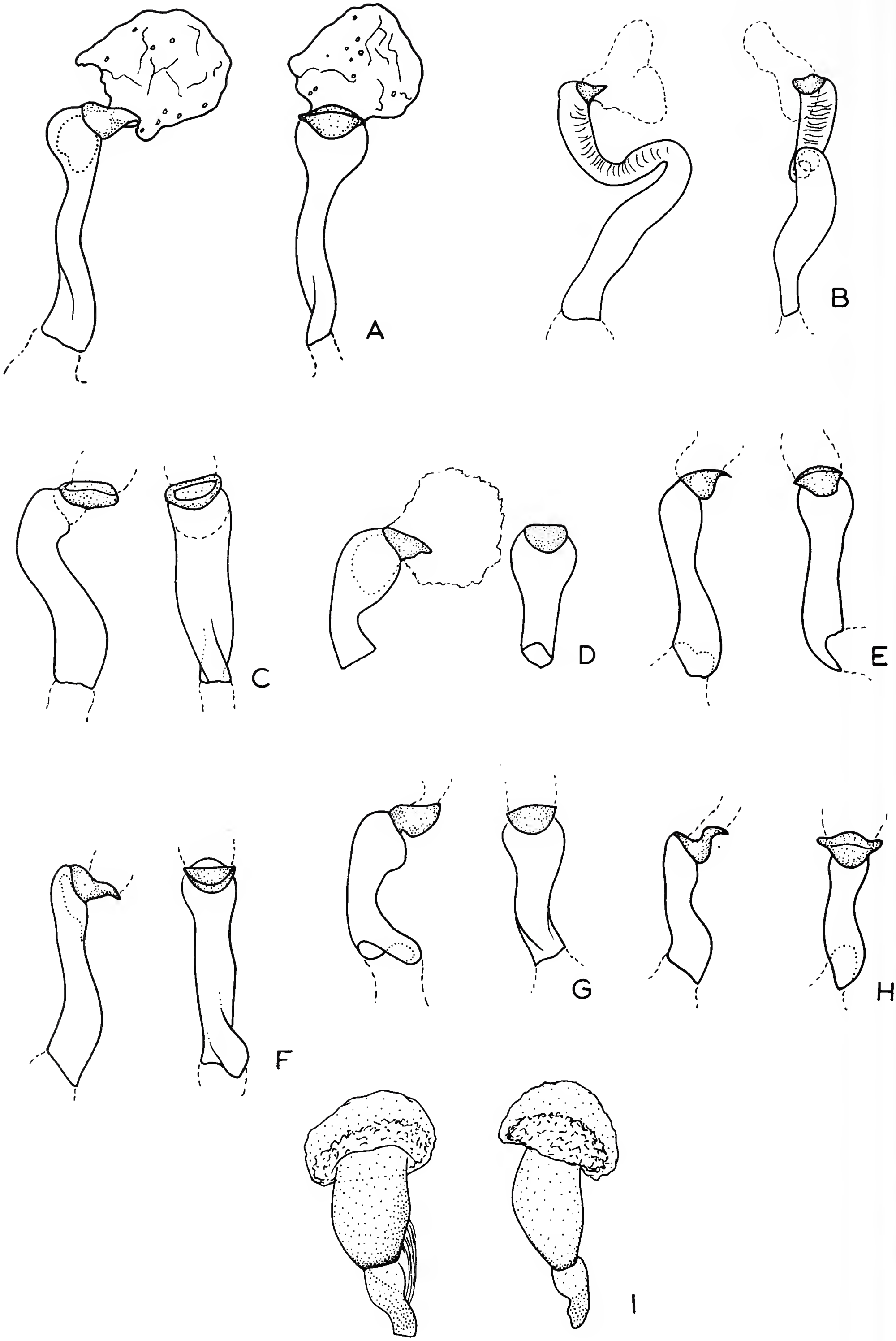
Females of New World hydraenids have a sclerotized spermatheca provided with an accessory gland and connected to the bursa copulatrix by a spermathecal duct. The spermathecal duct is very short, in *Gymnochthebius* females, or quite elongate, in *Limnebius* females. Generally, the spermatheca has a lightly sclerotized, flexible central region and muscles connecting the more heavily sclerotized proximal and distal portions (Figs. 9I,10B,H). Contraction of these muscles presumably causes the central region to flex, thereby acting as a pump mechanism.

Spermathecae vary considerably in shape between females of most genera, and between some species groups (cf. *G. oppositus* and *G. germaini*, Figs. 9E,I). Females of a few closely related species differ in spermathecae form, (cf. *G. laevipennis G. perlabidus* and *G. maureenae*, Figs. 93H-J). Such differences between sister-species, however, are exceptional.

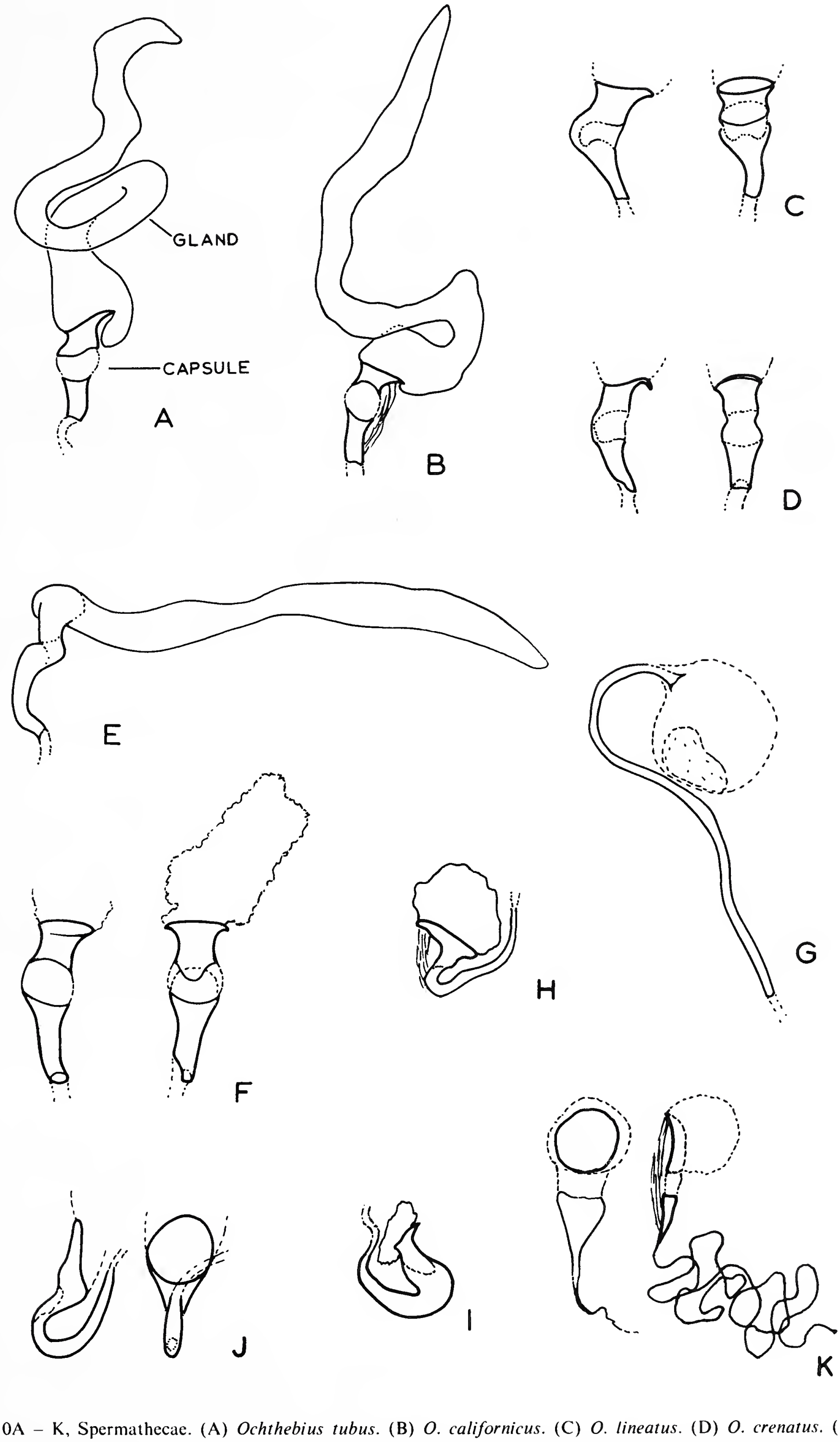
Representative spermathecae are illustrated (Figs. 9A-I,10K). The highly convoluted spermatheca of *Meropathus vectis* (Fig. 146C) is the most unusual.

Stridulatory Structures

Adults of a number of species in the *leechi* Group of New World *Hydraena* (all of the *leechi* and *alternata* Subgroups plus certain species in the *scintillabella* Subgroup) have a flat, smooth, generally oval and totally impunctate surface at the midpoint of the anterior pronotal margin (Figs. 31C,E,G,32B,40D). Viewed with the intense light of the microscope, this previously unreported structure appears as a small, brassy reflection; hence it is termed a "scintilla" (Latin for spark). I am grateful to Hugh B. Leech for bringing this structure to my



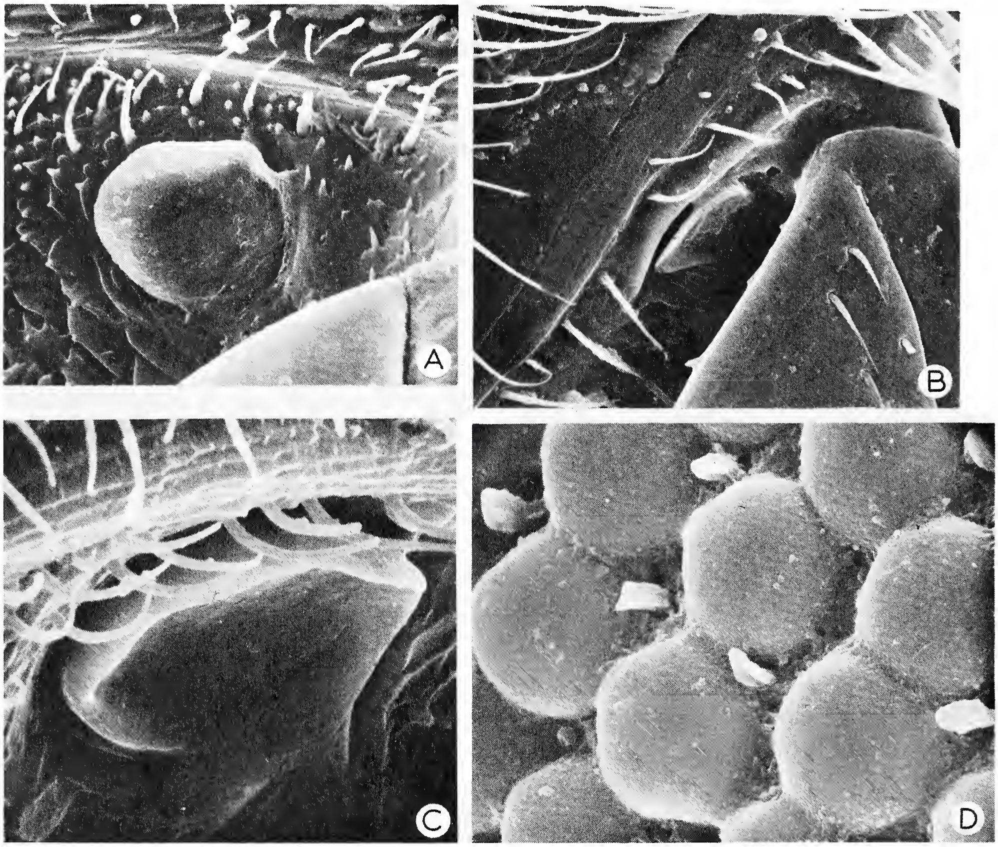
Figs. 9A – I, Spermathecae of *Gymnochthebius* species. (A) *G. clandestinus*. (B) *G. topali*. (C) *G. bartyrae*. (D) *G. compactus*. (E) *G. germaini*. (F) *G. curvus*. (G) *G. chilenus*. (H) *G. tectus*. (I) *G. oppositus*.



Figs. 10A – K, Spermathecae. (A) *Ochthebius tubus*. (B) *O. californicus*. (C) *O. lineatus*. (D) *O. crenatus*. (E) *O. benefossus* (F) *O. obscurus*. (G) *Parhydraenida reichardti*. (H) *Spanglerina brevis*. (I) *Hydraena circulata*. (J) *H. arizonica*. (K) *Limnebius sinuatus*.

attention at the outset of this study.

Viewed with the scanning electron microscope, the scintilla is seen to be an extremely thin shelf above a specialized area on the occipital region of the head (Figs. 31A,D,32A,C,40A,C). This region is transverse ridged in males, but these ridges are absent from females. There is little doubt that these interesting structures function together as a stridulatory device.



Figs. 11A – D. (A) Metacoxal sensillum, *Ochthebius tubus*. (B) Metacoxal sensillum, *Limnebius sinuatus*. (C) Metacoxal sensillum, *Parhydraenida reichardti*. (D) Surface of eye, *P. reichardti*.

Presence of debris on each side of the occipital ridges in the specimen of *Hydraena arizonica* illustrated (Figs. 32A,C) nicely confirms the supposition that the scintilla is rubbed against these ridges; absence of debris clearly indicates the area of contact. Absence of ridges from females suggests that perhaps stridulation functions as a recognition signal between opposite sexes of a species, rather than merely a warning signal. Apparently females, which have a smaller scintilla than their respective male counterparts, have either lost the ridges, or the influence of the genes which cause expression of the scintilla in males is so pervasive that the scintilla is also formed in females although it is without function (a similar phenomenon with respect to sexual dimorphism appears in species of *Hydraena*, such as *Hydraena d-destina*, in which the male metatibiae are greatly expanded and the females slightly so).

Interspecific variation in number, spacing and shape of ridges has been seen on the few species which have been studied with the scanning electron microscope, and I suspect these differences to result in a different pitch for each species.

Adults of seven species of the *leechi* Subgroup, the single species of the *alternata* Subgroup, plus most of the 17 species in the *scintillabella* Subgroup, have the scintilla well developed. Adults of a few species in the *scintillabella* Subgroup, such as *Hydraena exilipes* and *Hydraena ozarkensis*, have the scintilla very narrow (Fig. 40D). It reaches minimum expression in *Hydraena colombiana* adults.

Pronotal sensilla

Adults of *Limnebius* have four moderately distinctive, short setae near the anterior margin of the pronotum, and six similarly sized and spaced setae near the posterior margin (Fig. 69A). Brown (1932), in his description of *L. columbianus*, was the first author to mention these setae. Later, d'Orchymont (1945b) noted that these setae were present in all of the *Limnebius* material he had studied, and suggested that perhaps they were of generic significance.

Examination by scanning electron microscopy has revealed these setae on the pronota of adults of certain species of *Hydraena*, *Parhydraenida*, *Gymnochthebius*, and *Ochthebius* (Figs. 15E,F,48C,82C,106C,128A). I have not searched for these setae in all species, but this preliminary survey indicates that these structures are generally found in adults with relatively smooth surfaces, but are frequently absent from or obscured in adults with coarsely sculptured surfaces.

The constant morphological location of these setae and their presence in species from all of the major phylogenetic lineages indicates that their presence is a plesiotypic character state, and also suggests that they serve some sensory function. Discovery of these pronotal sensilla in a sublineage of either the Hydrophiloidea or Staphylinoidea would aid in determining the phylogenetic relationships of the family Hydraenidae.

Metacoxal sensilla

Adults of *Parhydraenida*, *Hydraena*, *Spanglerina*, *Limnebius*, *Gymnochthebius* and *Ochthebius* possess a curious, disc-shaped structure on the hind coxa (Figs. 11A-C,16C,21D,57B,65C). This "pad", a previously unreported morphological feature of the family, appears to be situated on the hind coxae so that flexure of the metatibia causes contact between the anterior surface of the metatibia (and/or the trochanter) and the "pad".

Function of this pad is a matter of conjecture; I can only suggest that perhaps it serves as a pressure sensor. Water flowing over the beetle (from anterior toward posterior as the insect faces into the current) would force the body backward slightly, causing the anterior surface of the metatibia to contact the metacoxal pad sensilla. Pressure on these sensilla might possibly, therefore, be directly proportional to flow rate and serve to monitor the beetle's position. Lateral water flow might cause pressure on only one sensillum, and therefore not only detect flow rate, but also direction relative to the beetle.

I have not found these sensilla in *Meropathus* adults (using light microscopy), which may indicate secondary loss associated with terrestrial habits.

These metacoxal pad sensilla are probably a primitive character for the family, as they are found in diverse lineages. Discovery of these structures in a sublineage of the Hydrophiloidea or Staphylinoidea would aid in phylogenetic placement of the family Hydraenidae.

KEY TO GENERA OF WESTERN HEMISPHERE HYDRAENIDAE

1 Antenna with eleven articles (Figs. 16B,148B); maxillary palpomeres 2 and 4 subequal in length, 3 about one-half length of 4 (Figs. 16A,148B); venter of head grooved for reception of antennae (Fig. 16A); South America 2

1′ Antennae with nine articles (Figs. 69H,148A,C,D); maxillary palpus various, not as above (Figs. 21A,69B,128C,148A,C,D); venter of head not grooved for reception of antennae (Figs. 21H,128C); North and South America 3

2 (1) Pronotum subcordate, sides sinuate near posterior angles (Figs. 15A,17A-H); elytra with serial rows of punctures in sulcate impressions, intervals costate or subcostate (Fig. 16F); aedeagus with left paramere inserted near apex, right paramere absent or reduced to small spike near apex (Figs. 18A-D) .... *Parhydraenida* J. Balfour-Browne, p. 45

2′ Pronotum with sides straight near posterior angles (Figs. 12A,C); elytra with serial rows of punctures not in sulcate impressions, intervals flat or slightly rounded; aedeagus with both parameres elongate, inserted near base (Figs. 13A,B) .... *Hydraenida* Germain, p. 40

3 (1′) Maxillary palpomere 3 longer and broader than 4 (Figs. 98B,103C,148A); pronotum with transparent or semi-transparent borders at anterior and posterior margins, with or without transparent lateral margins also (Figs. 96A-F) 4

3′ Maxillary palpomeres 3 and 4 subequal in length (Figs. 69B,148D), or with 3 much shorter than 4 (Figs. 48A,148C); pronotum without transparent borders 7

4 (3) Elytra interlocked, wings absent; eyes reduced, facets very convex (Figs. 145A-C,146A,B); pronotum without lateral transparent borders; intertidal or coastal species 5

4′ Elytra not interlocked, wings present; eyes not reduced, facets less convex (Fig. 103B); pronotum with lateral transparent borders more or less developed (Figs. 96A-F); primarily fresh or brackish water species 6

5 (4) Size large (ca. 2.30 mm long) with well developed dorsal pubescence (Fig. 146A); aedeagus without parameres; one species from Isla de los Estados and Falkland Islands .... *Meropathus* Enderlein, p. 406

5′ Size small (ca. 1.65 mm long) without well developed dorsal pubescence (Figs. 145A-C); aedeagus with parameres (Fig. 146D); one intertidal species, found on the Pacific coast from British Columbia to California .... *Neochthebius* d'Orchymont, p. 408

6 (4′) Aedeagus with apex of main-piece bifid; single process between lobes, extended or not beyond main-piece. Parameres longer than main-piece (Figs. 81A,B,84A-D). Pronotum of many specimens with sides of sclerotized part deeply emarginate in both anterior and posterior 0.50; between these emarginations sides produced in sharp point (Figs. 80A,96B); anterior margin of pronotum deeply emarginate in front of lateral fossulae; anterior angles lobate, markedly so in some specimens less so in others (North, Central and South America). In other South American specimens anterolateral emargination less developed (Fig. 80C), anterior angles less lobate; in still

others (Fig. 80E) anterolateral emargination very shallow, pronotum similar to that of some adults of *Ochthebius (sensu stricto)*. In few adults, angulation between antero- and posterolateral emarginations very large, exceeding in size lobe formed by anterior angles of pronotum (Figs. 89D,E); North and Central America .... *Gymnochthebius* d'Orchymont, p. 244

6′ Aedeagus with main-piece not bifid at apex; single, preterminal, articulated process extended beyond apex of main-piece. Parameres shorter than main-piece (Figs. 100A-D). Pronotum with sclerotized part of diverse forms (Figs. 96A,C-F), but not with markedly lobate anterior angles as described above. Pronotum of some specimens very transverse, sides gradually rounded from anterior angles to behind the middle, then deeply notched (Subgenus *Asiobates*, Figs. 133A-F). Pronotum of many specimens with sides sinuate and convergent to base (*Ochthebius (sensu stricto)*, Figs. 119A-H) .... *Ochthebius* Leach, p. 292

7 (3′) Maxillary palpus with second segment very elongate, much longer than third (Fig. 148C) 8

7′ Maxillary palpus with second and third segments subequal in length (Fig. 148D); sides of body evenly arcuate (Fig. 69A) ... *Limnebius* Leach, p. 222

8 (7) Pronotum markedly angulate in middle, with median ridge and anterointernal foveolae (Fig. 65E); labium with depressions near anterior margin (Fig. 65F); procoxae as widely separated as mesocoxae (Fig. 65D); metacoxae widely separated (Fig. 65C) .... *Spanglerina*, new genus, p. 212

8′ Pronotum very weakly to moderately angulate in middle, without a median ridge and anterointernal foveolae (Figs. 21C,48C,54C); labium without depressions near anterior margin (Figs. 21H,48E,54D); procoxae closer together than mesocoxae (Figs. 21D,E,48H,54B); metacoxae usually not widely separated (Figs. 21D,48D,54B) .... *Hydraena* Kugelann, p. 60

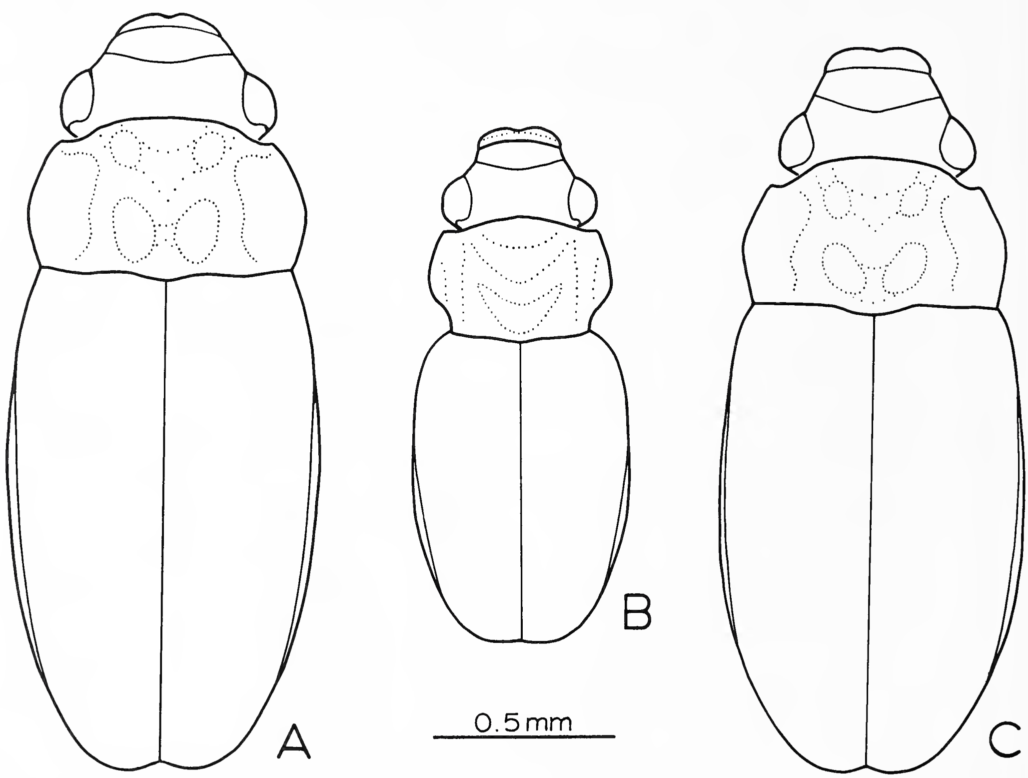
CHECKLIST OF WESTERN HEMISPHERE HYDRAENIDAE

GENUS *HYDRAENIDA* GERMAIN

Hydraenida Germain, 1901: 531 (type species: *Hydraenida ocellata* Germain, 1901: 536). – d'Orchymont, 1929: 96. – J. Balfour-Browne, 1975: 44.

Discussion. – As d'Orchymont (1929) pointed out, the eleven segmented antenna is the unusual structure of adults of this genus, not the ocelli as Germain(1901) had thought. Also of significance, but not mentioned by d'Orchymont or J. Balfour-Browne (1975) is form of the ventral surface of the head, which is grooved laterally for reception of the antennae. *Hydraenida* adults share this feature with the adults of *Parhydraenida* (Fig. 16A) and of the African genus *Coelometopon.* A discussion of relationships of *Hydraenida* are developed more fully in the section on phylogeny.

Specimens of this genus are still exceedingly rare in collections, although 77 years have elapsed since its description. In fact, only eight specimens other than those which Germain studied have been seen by subsequent specialists.



Figs. 12A – C, Body outlines. (A) *Hydraenida robusta.* (B) *Parhydraenida alida.* (C) *Hydraenida ocellata.*

The scant information available about habitat preferences of *Hydraenida* members consists of that given by Germain (1901), "de los arroyuelos que bajan por las quebradas de Quillota, Aculeo, Lo Aquila, etc.", plus H.P. Brown's label citation, "tributary to Rio Maule", the latter referring to the specimens of *H. robusta.* These notes suggest that adults of this genus are not

hygropetric as are adults of closely the related *Parhydraenida*. However, P. Spangler collected six specimens of *H. robusta* from a "roadside seep", a label citation which frequently identifies madicoles. Further field work is necessary to clearly establish habitat preferences of *Hydraenida* species.

Pronotal features. – Pronota of *Hydraenida* adults (Fig. 12A,C) are similar to those of *Parhydraenida* adults (Fig. 15A) in possession of lateral depressions and lateral fossulae. *Hydraenida* adults differ in that the anterior foveae and posterior foveae are not united to form U-shaped depressions as they are in *Parhydraenida* adults. Also, the pronotum of *Parhydraenida* adults is cordiform whereas that of *Hydraenida* adults is not.

Diagnosis. – Adults of this genus shares with those of *Parhydraenida*: 1) antennomeres 11, (Fig. 16B); 2) grooves on venter of head into which the antennae are inserted, (Fig. 16A); 3) form of the maxillary palpus (Fig. 16A); 4) form of the metasternum, and most other characteristics. Differences are in the elytral sculpture, which has the primary serial rows of punctures very weakly striate-impressed, if at all, and the intervals very slightly rounded. In *Parhydraenida* adults the primary rows are sulcate-impressed (Fig. 16F) and the intervals subcostate or costate. Additionally, pronota of *Hydraenida* adults have the sides straight at the rear (Fig 12A,C) whereas the sides are sinuate in *Parhydraenida* (Fig. 15A,17A-H), forming a subcordate shape. The aedeagi of *Hydraenida* males have the parameres attached at the base and elongate (Fig. 13A,B), whereas those of *Parhydraenida* males are usually very short and attached near the apex, the right reduced to a spike or absent (Fig. 18A-D) (refer to the discussion section of *Parhydraenida* for further comments).

Description. – *Form:* Elongate-oval, moderately convex (Fig. 12B,17A-H) *Size:* Length 2.00-2.20 mm, width 0.85-0.95 mm. Most females slightly larger than males. *Color* Dark brown. *Head:* Moderately punctate, markedly microreticulate dorsally. Interocular foveae shallow. Interocular tuberculi (ocelli) present. Clypeus transverse, sides convergent. Labrum with anterior margin weakly upturned in males, shallowly emarginate in females. Maxillary palpus moderately long, last three segments with approximate ratio of 2:1:2. Mentum trapezoidal, width at base equal length; microreticulate; anterior margin straight. Genae swollen in midregion, grooved laterally for reception of antennae. Antennae 11 segmented (6+5). *Thorax:* Pronotal sides straight at rear. Anterior margin markedly bisinuate, middle 0.20 straight or nearly so, anterior angles produced. Lateral depression with moderately impressed longitudinal fossula, strongly microreticulate. Disc with two pairs of moderately impressed foveae, anterior pair joined to one another by shallow depression. Posterior margin of pronotum slightly arcuate to rear in midregion. Prosternum slightly elevated transversely, coxae contiguous. Metasternum entirely hydrofuge pubescent, longitudinally depressed in midline. *Elytra:* Disc with six rows of small punctures, each puncture with a seta; rows very slightly striate-impressed near suture, not striate elsewhere. Intervals rounded slightly or flat, nearly three times width of primary serial punctures; each interval with row of punctures nearly equal in size to those of primary rows; each puncture with seta subequal to those of primary rows. Declivity beginning near posterior 0.33. Explanate margin weakly developed. *Abdomen:* Basal four sterna and anterior 0.25 of fifth sternum hydrofuge pubescent, remainder shiny, finely sparsely pubescent. *Legs:* Of moderate length and build. *Genitalia:* Aedeagus with parameres attached near base.

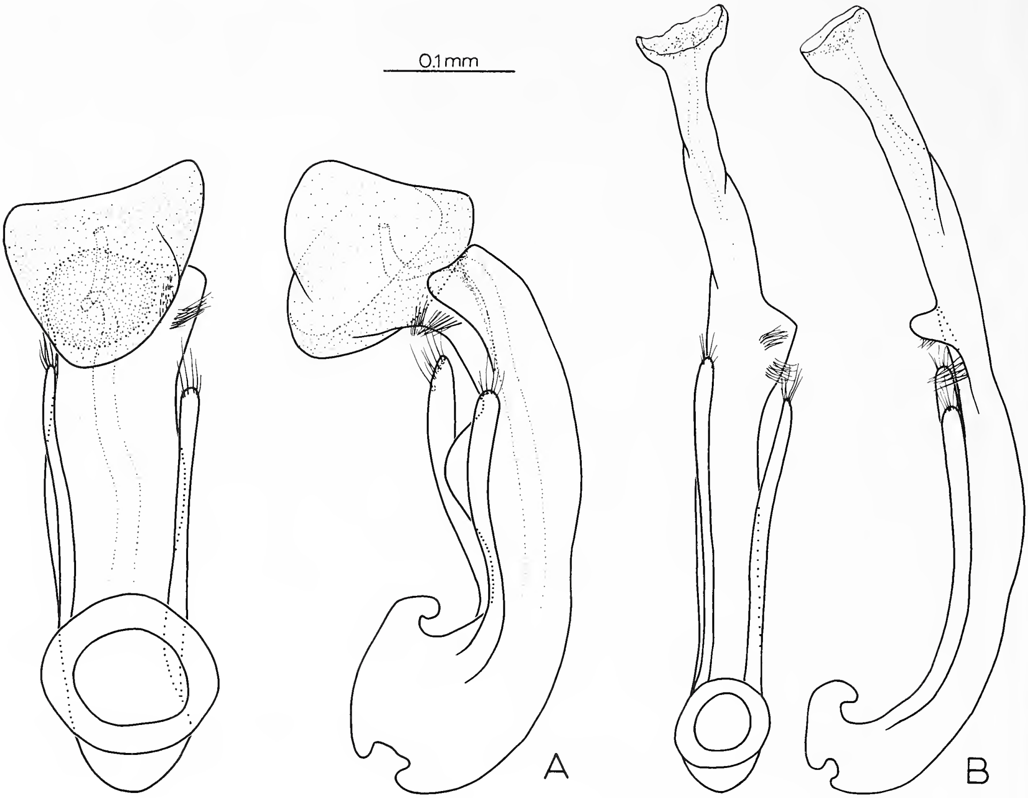
1. *Hydraenida ocellata* Germain
(Figs. 12C,13B,14A)

Hydraenida ocellata Germain, 1901: 531 (lectotype male deposited in MHNC; type-locality: Quillota, Chile). – d'Orchymont, 1929:96. – J. Balfour-Browne, 1975:44.

A lectotype for this species has been designated by J. Balfour-Browne (1975).

Diagnosis. – Adults of this species are slightly smaller and have the dorsal microreticulation slightly more developed than have adults of the very similar *H. robusta*. The only totally reliable means of differentiating these two species is by referral to the remarkably dissimilar aedeagal forms (Figs. 13A,B)of males.

Description. – *Form:* Elongate, oval, moderately convex (Fig. 12C). *Size:* Approximately 2.00 mm long, 0.85 mm wide. *Color* Dark brown. *Head:* Length 0.38 mm; width 0.56 mm. Frons markedly microreticulate, punctures obsolete,



Figs. 13A – B, Aedeagi of *Hydraenida* species. (A) *H. robusta*, holotype. (B) *H. ocellata*.

interocular foveae shallow, width of each nearly 0.66 distance separating them; interocular tuberculi large; basomedial fovea absent. Frontoclypeal suture bisinuate. Clypeus length slightly less than 0.50 width; markedly microreticulate. Labroclypeal suture straight. Labrum length 0.50 width, strongly microreticulate; anterior margin weakly emarginate, but weakly upturned margin gives the appearance of a nearly straight anterior edge in habitus view. Maxillary palpomere 4 (apical) slightly longer than 2 (pseudobasal); palpomere 3 about 0.50 length of 4. Mentum trapezoidal, width at base equal length; microreticulate finely punctate,; anterior margin straight. Submentum punctulate. Genae swollen, dull, punctulate, grooved laterally. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.46 mm; maximum width (near anterior 0.33) 0.76 mm. Anterior margin bisinuate, anterior angles produced. Lateral depressions markedly microreticulate, punctures nearly obscured by microreticulation; sides not apparently crenulate, straight from near anterior 0.33 to posterior angles. Lateral fossulae very shallow, with same sculpture as lateral depressions. Pronotal disc markedly microreticulate, densely punctate, dull except for small shiny area in midline slightly behind middle; with anterior and posterior pair of moderately impressed foveae, anterior pair joined to one another by shallow depression. Posterior margin weakly arcuate to rear in midregion. Prosternum slightly elevated along anterior margin; coxae contiguous. Metasternum longitudinally impressed at midline, entirely hydrofuge pubescent. *Elytra:* Length 1.36 mm; maximum width (near midlength) 0.85 mm, Disc shiny, much more reflective than pronotum. shallowly depressed in midregion, with six rows of small punctures between suture and humeri, rows extremely slightly striate impressed on disc; each puncture with short seta. Intervals flat or very slightly rounded, nearly three times width of punctures in shallow striae; each interval with row of punctures nearly equal in size to those of primary rows; each puncture with seta subequal to those of primary rows. Declivity beginning near posterior 0.33. Explanate margin slightly developed. *Abdomen:* Basal four sterna and anterior 0.25 of fifth sternum hydrofuge pubescent, remainder shiny, finely sparsely pubescent. *Legs:* Of moderate length and build. *Genitalia:* Male (Fig. 13B) (1 examined).

Natural History. – Germain (1901) states: “Este insecto es anchamente oblongo i deprimido; i se halla, por los meses de verano, pegado en la parte inferior de las piedras medio

sumerjidas de los arroyuelos que bajan por las quebradas de Quillota, Aculeo, Lo Aguila, etc.".

Distribution. – (Fig. 14A). Central Chile, in Valpariso Province (Quillota) and, according to J. Balfour-Browne (1975) Santiago Province (Aculeo and Hospital).

Remarks. – It is remarkable that neither d'Orchymont (1929) nor J. Balfour-Browne (1975) nor myself have seen specimens other than those which were before Germain at the time of the original description (1901).

2. *Hydraenida robusta* new species
(Figs. 12A,13A,14A)

Type-locality. – Tributary to Rio Maule, Maule Province, Chile.

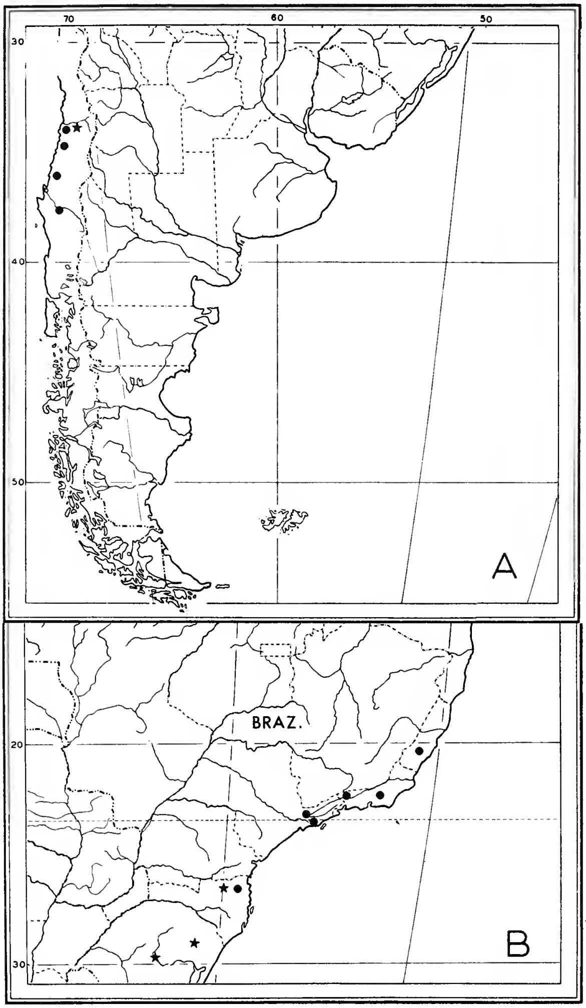
Type-specimens. – The holotype male is deposited in USNM. This specimen was collected by Harley P. Brown on November 2, 1971. The allotype, collected by H.P. Brown on November 1, 1971, is from Colchagua Province, e. Aguas Buenas, and is also deposited in USNM. One male and one female paratype from Valpariso Province, Quillota (originally part of Germain's type series of *H. ocellata*), are deposited in MHNC. Six paratypes (three of each sex) deposited in USNM have the following data: Chile, Bio-Bio Prov., Santa Barbara (1 km S.) roadside seep, 25-Jan.-1978, P.J. Spangler.

Diagnosis. – Males of this species are distinguished from those of *H. ocellata* by differences in the aedeagus. Females of the two species cannot be distinguished from one another by structural characteristics.

Description. – *Form:* Elongate oval, moderately convex (Fig. 12A). *Size:* Holotype 2.20 mm long, 0.92 mm wide. *Color* Head and pronotum dark brown, remainder brown. *Head:* Length 0.40 mm; width 0.62 mm. Frons markedly microreticulate, punctures nearly obscured; interocular foveae shallow, width of each nearly 0.66 distance separating them; interocular tuberculi large; basomedial fovea shallow, transverse. Frontoclypeal suture bisinuate. Clypeus length slightly less than 0.50 width; small anteromedial area shiny, remainder dull, markedly microreticulate. Labroclypeal suture straight. Labrum length 0.50 width; markedly microreticulate, moderately densely pubescent; anterior edge straight, upturned. Maxillary palpomere 4 (apical) slightly longer than 2 (pseudobasal); palpomere 3 0.50 length of 4. Mentum trapezoidal, concave, width at base equal length; microreticulate, finely punctate; anterior margin straight. Submentum concave, markedly microreticulate. Genae swollen, dull, punctulate, grooved laterally for reception of antennae. Postgena punctulate. *Thorax:* Pronotum length at midline 0.50 mm; maximum width (near anterior 0.33) 0.82 mm. Anterior margin bisinuate, anterior angles produced. Lateral depressions markedly microreticulate, moderately punctate; sides apparently not crenulate, or extremely finely so, straight from near midlength to posterior angles. Lateral fossulae with sculpture as lateral depressions. Pronotal disc markedly microreticulate, densely punctate, dull except for shiny relief in middle; with an anterior and a posterior pair of well impressed foveae, the anterior pair joined one to the other by a shallow depression to form a V-shaped figure. Posterior margin arcuate to rear in midregion. Prosternum very slightly elevated in midline; coxae contiguous, metasternum longitudinally depressed in midline, entirely hydrofuge pubescent. *Elytra:* Length 1.48 mm; maximum width (near midlength) 0.92 mm. Disc shiny, much more reflective than pronotum, shallowly depressed in midregion, with six rows of small punctures between suture and humeri, rows extremely slightly striate impressed; each with a distinctive short seta. Intervals flat or very slightly rounded, nearly three times width of punctures in shallow striae; each interval with a row of punctures about 0.50 the size of punctures in primary rows; each puncture with a seta subequal in size to those of primary rows. Declivity beginning near posterior 0.33. Explanate margin weakly developed. *Abdomen:* Basal four sterna and anterior 0.25 of fifth hydrofuge pubescent, remainder shiny, finely sparsely pubescent. *Legs:* All legs of moderate length and build. Protarsi with large pad of suction setae on basal three segments. Mesotarsi also apparently with suction setae on basal three segments, although not forming pads. All claws with a small tooth on lower surface near base, those of protarsi slightly larger than others. *Genitalia:* Male (Fig. 13A) (two examined).

Variation. – Females lack pro- and mesotarsal suction setae and do not have the anterior margin of the labrum upturned.

Distribution. – (Fig. 14A) Central Chile, in the provinces of Valpariso, Colchagua, Bio-Bio, and Maule.



Figs. 14A – B, Geographical distributions. (A) *Hydraenida robusta* ● and *H. ocellata* ★. (B) *Parhydraenida reichardti* ● and *P. effeminata* ★.

Etymology. – Latin, *robusta* (strongly built). I refer to the very stout aedeagus.

Remarks. – J. Balfour-Browne (1975) illustrated the aedeagus of a species of *Hydraenida* which he preferred not to describe because the adult body had been fragmented due to "treatment with caustic potash". The illustration he provides agrees well with that of *H. robusta* except for the shape of the apical piece; it seems likely that the caustic potash mentioned above deformed the aedeagus of his specimen.

GENUS *PARHYDRAENIDA* J. BALFOUR-BROWNE

Parhydraenida J. Balfour-Browne, 1975:39 (type species: *Parhydraenida reichardti*, 1975: 40).

Discussion. – This interesting genus was recently described by J. Balfour-Browne (1975) for four species of hydraenids found in the mountains of southeastern Brazil. In justifying establishment of this genus, Balfour-Browne states, "By the 11-segmented antennae, distinct ocelli and most other characters this group might well be attached to *Hydraenida* Germain but the almost cordate pronotum and the absence of aedeagal parameres demand that they be separated therefrom."

Close inspection of the aedeagus, however, reveals that it invariably has a left paramere, and most have a spike-like process which I regard as a remnant of the right paramere. This is true for the three species Balfour-Browne described (one species is known only by females) and for the four new species described herein.

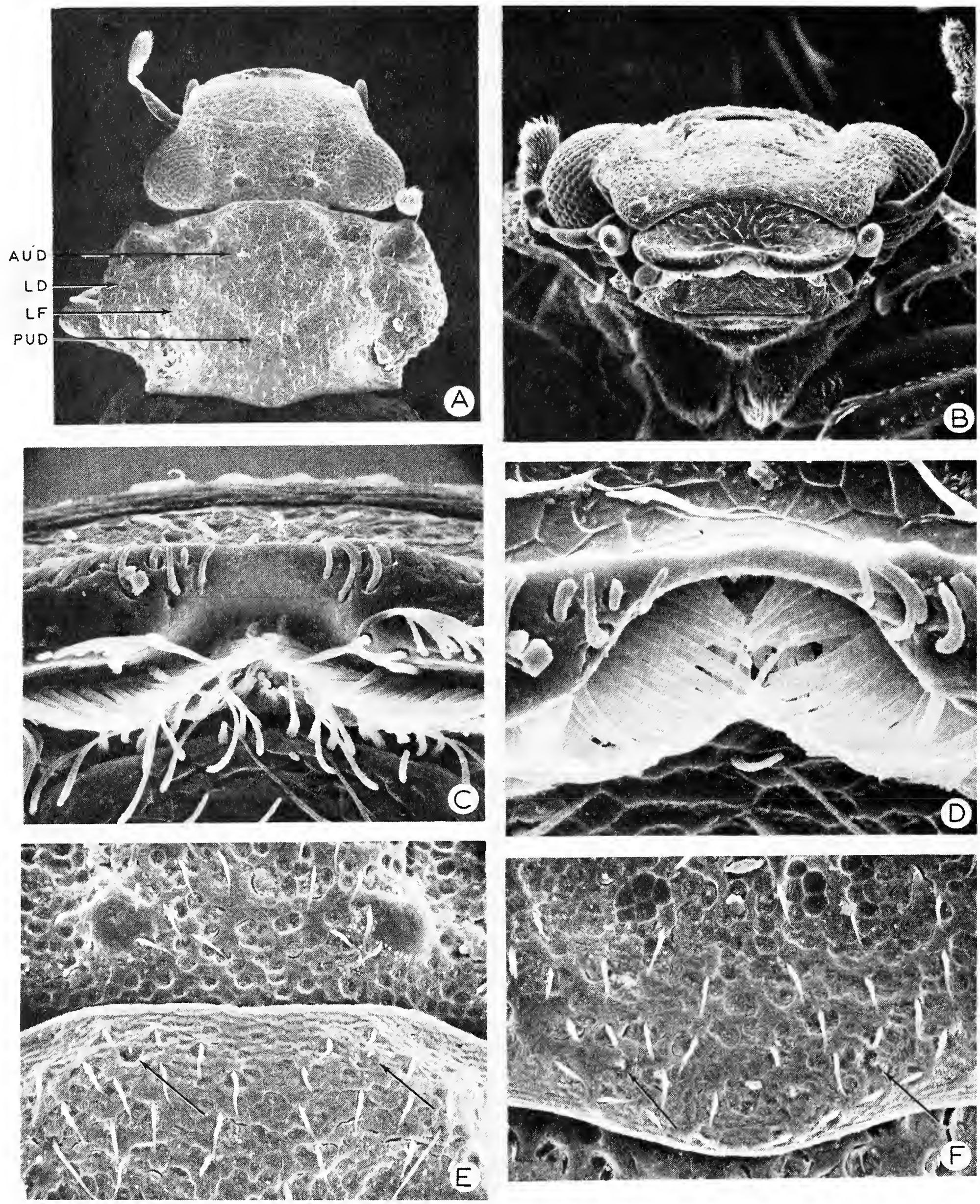
The left paramere has apical setae, typical for this structure, in all species except one, *P. lambda*. In this species the left paramere is greatly reduced in size (Fig. 18D) and somewhat spike-like. It is the shape of the left paramere in *P. lambda* males that suggests that the other spike-like process, near the apex of the aedeagus, is the vestigial right paramere. This proposed vestigial, spike-like paramere characterizes males of the following four species: *P. reichardti*, *P. lambda*, *P. quadraticeps*, and *P. hygropetrica*. The aedeagus of *P. bubrunipes* males has a setose swelling near the apex which is probably derived, at least in part, from the right paramere (Fig. 19).

P. paralonga males have a relatively long left paramere, about 0.33 the total length of the aedeagus (Fig. 20A). In males of other species this paramere is much smaller relative to aedeagal length.

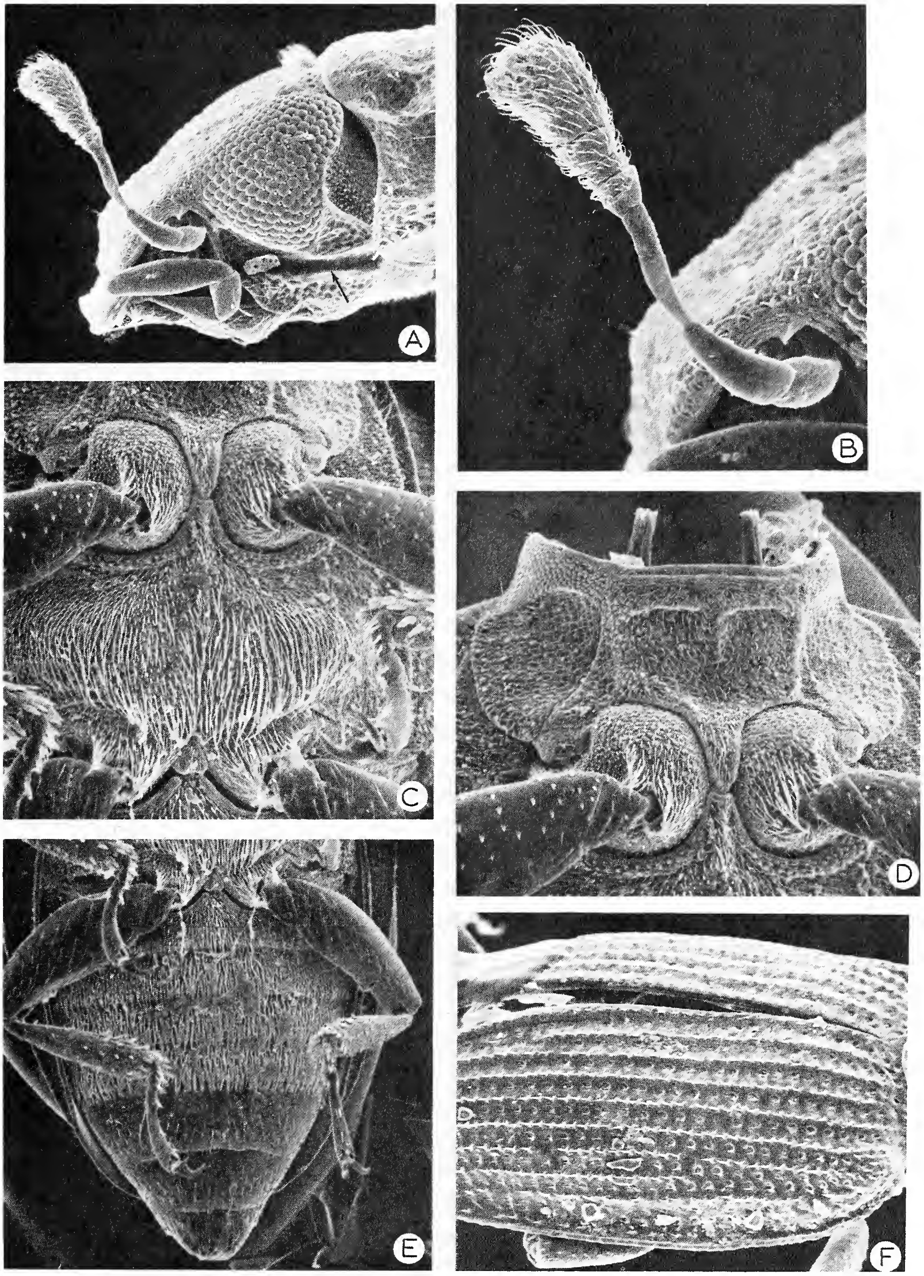
In contrast to the parameres of *Hydraenida*, however, those of *Parhydraenida* are inserted near the apex of the aedeagus and are very short; those of *Hydraenida* are long and inserted near the base (Figs. 13A,B). Additionally, the aedeagus of *Hydraenida* males is straight, whereas that of *Parhydraenida* males appears to be twisted. This twisting is reflected in the shape of the aedeagal base where the ejaculatory duct enters, which is displaced to the left.

The subcordate pronotum emphasized by Balfour-Browne has been found to be consistently present in the adults of the new species described herein. Additionally, all of the known adults have the elytral series sulcate impressed, which presents a much different appearance from the elytra characteristic of the two species currently known for *Hydraenida*. Based upon the aedeagal differences, mentioned above, plus the pronotal and elytral differences, I am considering this group worthy of generic status.

However, area and habitats which remain to be sampled in South America are so very extensive, and the morphological gap separating these two genera is so narrow, that the probability of intermediates being discovered would appear to be less than remote.



Figs. 15A – F, *Parhydraenida reichardti*, ♂. (A) head and pronotum (AUD = anterior U-shaped depression, LD = lateral depression, LF = lateral fossula, PUD = posterior U-shaped depression). (B) anterior aspect of head. (C,D) labral emargination. (E) ocelli and anteromedian region of pronotum (arrows indicate pronotal sensilla). (F) posteromedian region of pronotum.



Figs. 16A – F, *Parhydraenida reichardti*, ♂. (A) head, lateral aspect. (arrow indicates antennal groove). (B) antenna. (C) metasternum. (D) mesosternum. (E) abdomen. (F) elytra.

Judging from the unusual hydrofuge pubescence of *P. pentatenkta* adults from Ecuador, which is geographically quite removed from the remaining eight species of southeastern Brazil, even the discovery of the male of that species will add considerably to our knowledge of the genus.

I have seen two females of a species from Paraguay, which suggests that further collecting may eventually provide geographical intermediates between the southeastern Brazilian and Ecuadorian components of *Parhydraenida*. These two females probably represent an undescribed species. However, they are not sufficiently distinct to warrant formal description without the diagnostic features of the aedeagi that males would provide. Based upon ventral pubescence, these two females are members of the *reichardti* Group.

Pronotal Features. – The major relief features of *Parhydraenida* pronota (Fig. 15A) consist of an anterior (AUD) and posterior (PUD) U-shaped depression, rather broad lateral depressions (LD), and lateral fossulae (LF). In adults of most species the posterior U-shaped depression does not join the lateral fossulae, and the lateral fossulae are not divided into distinct anterior and posterior foveae (Figs. 17F-H). *P. reichardti* adults (Figs. 15A,17C), however, are an exception in both respects. Infrequently, as in adults of *P. effeminata* (Fig. 17E), the pronotal sculpture is very obsolete, with only a suggestion of the depressions seen in the other species.

Diagnosis. – Combination of eleven segmented antennae (Fig. 16B) and form of the maxillary palpus, which has the apical (fourth) segment about twice as long as the third and subequal that of the second (pseudobasal) (Fig. 148B), readily distinguish *Parhydraenida* adults from all those of New World genera of Hydraenidae except *Hydraenida*. Adults of these two genera are also unique in form of the ventral surface of the head, which is grooved laterally for reception of the antennae (Fig. 16A). The subcordate pronotum of *Parhydraenida* adults (Figs. 15A,17A-H), plus sulcate impressed elytral series (Fig. 16F) and aedeagal form, which has the left paramere inserted close to the apex and the right paramere absent or reduced to a spike, serve to distinguish them from adults of *Hydraenida*. In *Hydraenida* adults the pronotal sides are straight in the rear, the elytral series are not sulcate impressed, and the aedeagus has two long parameres which insert near the base.

Description. – *Form:* Generally elongate-oval, some adults somewhat truncate (Figs. 17A-H), moderately convex. *Size:* Length 1.50 to 2.20 mm, width 0.68 to 1.05 mm. Most females slightly larger than males. *Color* Most adults black, a few brown. *Head:* Moderately finely punctate to rugulose, generally with well developed microreticulation dorsally. Interocular foveae moderately to well developed. Interocular tuberculi (ocelli) prominent. Clypeus transverse, parallel sided to convergent anteriorly, some specimens with anterior angles deflexed. Labrum commonly with anterior margin straight and upturned in males, remarkably so in some species; females shallowly emarginate. Maxillary palpus moderately long, last three segments with approximate ratio of 2:1:2. Mentum trapezoidal, width at base approximately equal to length; generally finely microreticulate; anterior margin straight. Genae swollen in midregion, grooved laterally for reception of antennae. Antennae 11 segmented (6+5). *Thorax:* Pronotum with sides weakly to moderately sinuate at rear, subcordate in shape. Anterior margin very slightly to moderately bisinuate in habitus view, trisinuate in anterior view, anterior angles generally produced. Lateral depressions of most adults with moderately impressed fossula between lateral depression and disc, fossula infrequently interrupted in midlength in form of two separate depressions (*reichardti*); area between fossula and side of pronotum generally slightly convex; sides crenulate. Disc with two U-shaped depressions, well formed in most adults; posterior extremely shallow in few adults, generally well formed, in few adults joined to lateral fossulae by shallow depression; anterior U-shaped depression extended to anterior margin of pronotum, deepest near anterior margin in many adults. Posterior margin of pronotum arcuate to rear of midregion. Prosternum of most adults elevated in midregion, not carinate; anterior coxae contiguous. Metasternum entirely hydrofuge pubescent, longitudinally depressed in midline. *Elytra:* Disc with six rows of deeply impressed punctures between suture and humeri, each puncture with prominent seta; rows weakly to markedly sulcate impressed. Intervals subcostate to costate, each with row of setiferous punctures, punctures smaller than those of primary rows; first interval extended to apex in some adults, terminated near apical 0.25 in others. Explanate margin moderately developed. Sides at anterior angles serrate. *Abdomen:* Generally with basal four sterna plus anterior 0.25 of fifth sternum hydrofuge pubescent, remainder shiny. Hydrofuge pubescence in few specimens restricted to first two sterna plus anterior 0.25 of third (*P. pentatenkta*). *Legs:* Of moderate

length, rather stout, without apparent sexual dimorphism. *Genitalia:* Aedeagus with left paramere, although very small in many males, inserted near apex; right paramere absent or reduced to spike-like process, inserted near apex.

Key to Western Hemisphere species of *Parhydraenida*

1 Hydrofuge pubescence of abdominal sterna restricted to basal two plus anterior portion of third, remaining sterna shiny, very sparsely pubescent; Ecuador (Fig. 17B) .... *P. pentatenkta*, new species, p. 59

1′ Hydrofuge pubescence on sterna 1-4 plus anterior portion of fifth; southeastern Brazil 2

2 (1′) Clypeus with parallel sides .... *P. quadraticeps* J. Balfour-Browne, p. 49

2′ Clypeus with convergent sides 3

3 (2′) Lateral fossulae of pronotum discontinuous, divided by elevated portion of lateral depressions in form of deep depression near each angle of pronotum (Figs. 15A,17C) .... *P. reichardti* J. Balfour-Browne, p. 52

3′ Lateral fossulae not discontinuous 4

4 (3′) Large, ca. 2.20 mm long; brownish; fifth abdominal sternum with transverse band of short setae; clypeus markedly transverse (Figs. 17H, 19) .... *P. bubrunipes*, new species, p. 51

4′ Smaller, ca. 1.90 mm long or less; blackish; fifth abdominal sternum with sparse, random setae; clypeus not markedly transverse 5

5 (4′) Elytron with first interval (from suture) extended to just slightly before apex . 6

5′ Elytron with first interval ending near posterior 0.25 7

6 (5) Pronotum with posterior U-shaped depression well developed (Figs. 17G,18D) .... *P. lambda*, new species, p. 54

6′ Posterior U-shaped depression absent or nearly imperceptible (Fig. 17E) .... *P. effeminata* J. Balfour-Browne, p. 54

7 (5′) Pronotal reliefs moderately shiny, punctate, not microreticulate (Figs. 12B,20B) .... *P. alida* J. Balfour-Browne, p. 57

7′ Pronotal reliefs dull, microreticulate 8

8 (7′) Elytral rows deeply sulcate impressed; size larger, ca. 1.72 mm long; aedeagus as illustrated (Figs. 17D, 20A) .... *P. paralonga*, new species, p. 56

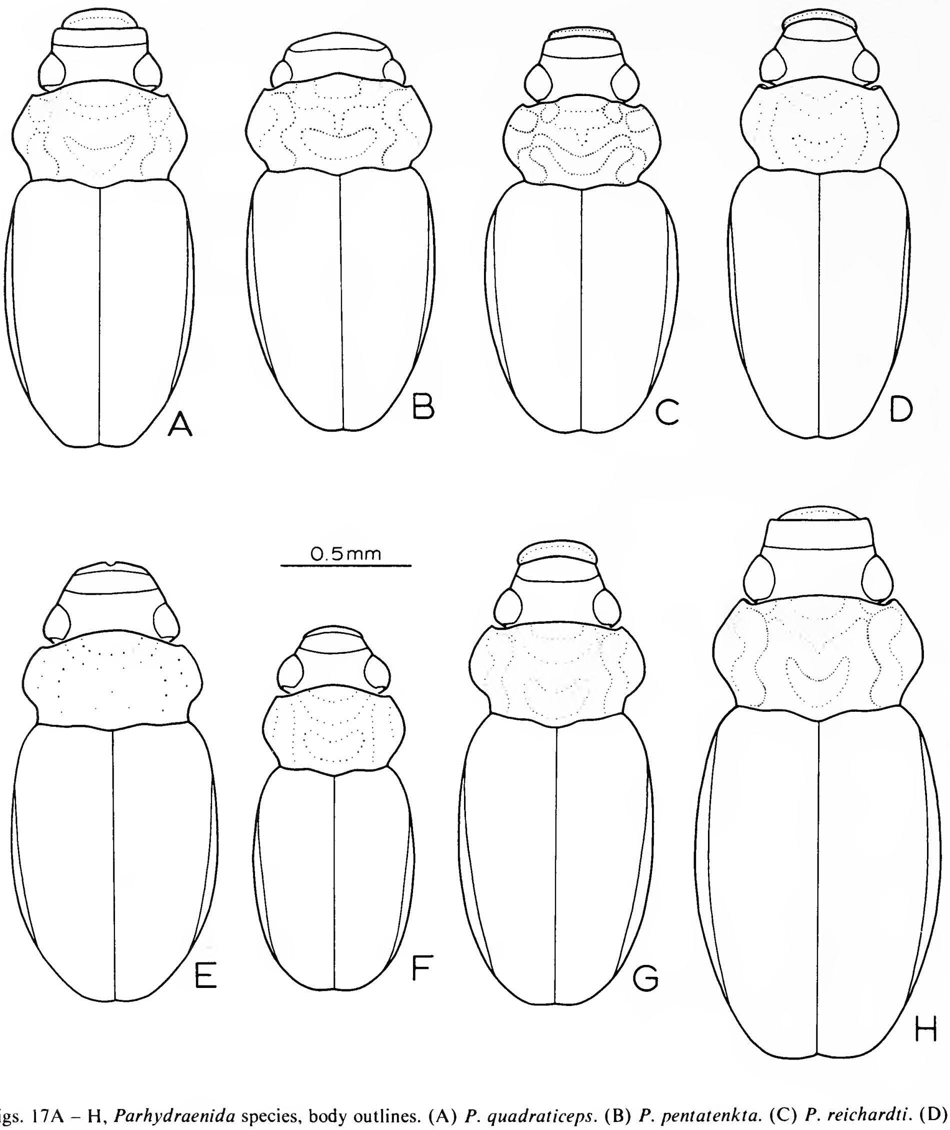
8′ Elytral rows shallowly sulcate impressed; size smaller, ca. 1.52 mm long; aedeagus as illustrated (Figs. 17F,18B) .... *P. hygropetrica*, new species, p. 57

1. *Parhydraenida quadraticeps* J. Balfour-Browne
(Figs. 17A,18C,162)

Parhydraenida quadraticeps J. Balfour-Browne, 1975:42. (holotype male, unique, deposited in MSP; type-locality: Morretes, Paranà, Brazil).

Diagnosis. – The parallel sided clypeus and aedeagal form serve as diagnostic features for this species. The strongly upturned labrum of males is also distinctive.

Description. – *Form:* Slightly truncate, moderately convex (Fig. 17A). *Size:* Holotype 1.76 mm long, 0.78 mm wide. *Color* Dorsum and venter black; legs, palpi and antennae brown. *Head:* Length 0.40 mm; width 0.52 mm. Frons finely microreticulate, moderately coarsely punctate in middle, very sparsely pubescent; interocular foveae moderately deep, subrugulose, width of each 0.66 distance between them; interocular tuberculi prominent; basomedial foveae absent. Frontoclypeal suture evenly arcuate. Clypeus length 0.33 width, sides parallel; anterior angles prominent, rounded;



Figs. 17A – H, *Parhydraenida* species, body outlines. (A) *P. quadraticeps*. (B) *P. pentatenkta*. (C) *P. reichardti*. (D) *P. paralonga*. (E) *P. effeminata*. (F) *P. hygropetrica*. (G) *P. lambda*. (H) *P. bubrunipes*. (to same scale).

sculpture as frons. Labroclypeal suture slightly arcuate to rear. Labrum length nearly 0.33 width; anterior margin straight, strongly upturned along entire width; sculpture as clypeus, although slightly more pubescent. Maxillary palpomere 4 (apical) slightly longer than 2 (pseudobasal); palpomere 3 shorter than 2. Mentum trapezoidal, width at base equal length, dull, finely microreticulate, very finely punctulate, anterior margin straight. Submentum finely microreticulate, finely punctulate. Genae dull, finely microreticulate finely punctulate, swollen; grooved laterally for reception of antennae. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.42 mm; maximum width (near anterior 0.33) 0.68 mm. Anterior margin shallowly bisinuate. Lateral depressions slightly convex, coarsely punctate, each puncture with short seta, finely microreticulate; sides crenulate, sinuate, not strongly produced laterally. Lateral

fossulae much deeper at anterior and posterior extremes, in form of four large foveae, posterior slightly larger than anterior. Pronotal disc rounded, sculptured as lateral depressions, with anterior and posterior, wide U-shaped depression; anterior depression extended to anterior margin; posterior depression with "arms" terminated on disc, clearly separated from lateral fossulae by convex area on each side of disc. Posterior margin of pronotum arcuate posteriorly in midregion. Prosternum elevated in midline, not carinate; coxae contiguous. Metasternum with large, longitudinal, median depression; entirely hydrofuge pubescent. *Elytra:* Length 1.06 mm; maximum width (near midlength) 0.78 mm. Disc shallowly depressed in middle, shiny, with six rows of large, deep punctures between suture and humeri, rows sulcate impressed. Declivity in posterior 0.33. Intervals subcostate, width less than puncture width; each with row of decumbent setae; first interval (from suture) extended to apex. Explanate margin moderately developed, terminated near posterior 0.25. Apices slightly truncate. *Abdomen:* Basal four sterna with hydrofuge pubescence. Sternum 5 hydrofuge pubescent in anterior 0.33, remainder shiny. Sternum 6 shiny, very sparsely pubescent, posterior margin arcuate to anterior in midline. Apical segment shiny, very sparsely pubescent. *Legs:* Moderately short and stout. *Genitalia:* Male (Fig. 18C) (one examined).

Variation. – I have tentatively identified two females, with the following data, as *P. quadraticeps*: Morretes, PR, km 37, Est. da Graciosa, Rio Cascata, 20-VI-1975, H. & B. Reichardt. The pronotal and elytral features of these females agree very well with those of the holotype. The sides of the clypeus, however, are slightly, but distinctly convergent, not parallel as in the holotype male. The labrum is emarginate and not strongly upturned. When series consisting of both sexes become available, they will probably reveal that the differences in clypeal shape are sex-associated as are differences in the labrum.

Distribution (Fig. 162). – Known only from the type locality, Morretes, Paranà, Brazil.

Remarks. – In the original description, J. Balfour-Browne (1975) states that the labrum has the "anterior edge in males straight, strongly raised with a sharply impressed transverse impression immediately behind....". By way of clarification, although the markedly upturned anterior margin forms a sharp angle with the remainder of the labrum, there is, however, no transverse sulcus distinct from the sloping, basal portion of the labrum.

2. *Parhydraenida bubrunipes* new species
(Figs. 17H,19,162)

Type-locality. – Nova Teutonia, Santa Catarina, Brazil.

Type-specimen. – The holotype male (unique) is deposited in MCZ. Fritz Plaumann collected this specimen in February, 1954.

Diagnosis. – Large size (2.20 mm long), brown color and strongly transverse clypeus are diagnostic features for this species. Additionally, the holotype is unique among the known species of *Parhydraenida* in possession of a transverse band of short setae on the fifth abdominal sternum in males, at least; females are unknown.

Description. – *Form:* Elongate oval, moderately convex (Fig. 17H). *Size:* Holotype 2.20 mm long, 1.04 mm wide. *Color:* Dorsum and venter dark brown; legs bright brown, contrasting well with venter; palpi testaceus in basal 0.50, apical 0.50 dark brown. *Head:* Length 0.40 mm; width 0.66 mm. Frons in middle coarsely closely punctate, interstices shining, very finely microreticulate, very sparsely pubescent; interocular foveae subrugulose, deep and large, width of each nearly 0.66 distance separating them; interocular tuberculi prominent; basomedial fovea absent. Frontoclypeal suture evenly arcuate. Clypeus length slightly less than 0.33 width, sides slightly convergent, anterior margin arcuate to rear, anterior angles prominent, rounded; surface subrugulose; viewed anteriorly front edge of clypeus markedly arcuate. Labrum length 0.33 width; anterior margin moderately upturned, arcuate in habitus view. Maxillary palpomere 4 (apical) slightly longer than 2 (pseudobasal); palpomere 3 slightly less than 0.50 length of 4. Mentum trapezoidal, dull, finely microreticulate. Submentum finely microreticulate. Genae swollen, shiny in midregion, microreticulate and grooved laterally for reception of antennae. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.50 mm; maximum width (near midlength) 0.90 mm. Anterior margin bisinuate in habitus view, trisinuate in anterior view. Lateral depressions convex, coarsely closely punctate, each puncture with a short but very apparent seta, finely microreticulate; sides crenulate, sinuate, strongly produced laterally. Lateral fossulae sinuate, posterior portion slightly deeper than remainder. Pronotal disc sculptured as lateral depressions, with anterior and posterior U-shaped depression; anterior U-shaped depression extended to anterior margin, anterior extremes connected to anterior portion of lateral fossulae by shallow depression; posterior

U-shaped depression with "arms" terminated on disc, not connected to lateral fossulae. Posterior margin arcuate to rear in midregion. Prosternum elevated in midline, not carinate; coxae contiguous. Metasternum broadly depressed in midregion, hydrofuge pubescent except for very small, shiny area anterior to and between posterior coxae. *Elytra:* Length 1.40 mm; maximum width (near midlength) 1.04 mm. Disc shiny, broadly depressed in middle, with six rows of large, deep punctures between suture and humeri, rows sulcate impressed. Declivity extended through posterior 0.33. Intervals costate, width slightly less than puncture width; first interval (from suture) extended to apices. Explanate margin well developed, ending near apical 0.16. Apices slightly truncate. *Abdomen:* Basal four sterna with hydrofuge pubescence. Sternum 5 hydrofuge pubescent in anterior 0.16, middle of sternum with transverse band of short setae in very shallow depression. Sternum 6 shiny, sparsely pubescent, posterior margin arcuate to front in midregion. Apical segment shiny, sparsely pubescent. *Legs:* Moderately long and stout. *Genitalia:* Male (Fig. 19) (one examined).

Distribution (Fig. 162). – Known only from the type locality of Nova Teutonia in the state of Santa Catarina, Brazil.

Etymology. – Latin, *bu* (large) plus *brun* (brown) plus *ipes* (foot). I refer to large size and brownish legs which contrast well with the remainder of the venter of the holotype.

3. *Parhydraenida reichardti* J. Balfour-Browne
(Figs. 10G,11C,D,14B,15A-F,16A-F,17C,18A,148B,149E,F,151C,152E,F,153D,E,162)

Parhydraenida reichardti J. Balfour-Browne, 1975: 42. (holotype male deposited in MSP; type-locality: Itatiaia, Rio de Janeiro, Brazil).

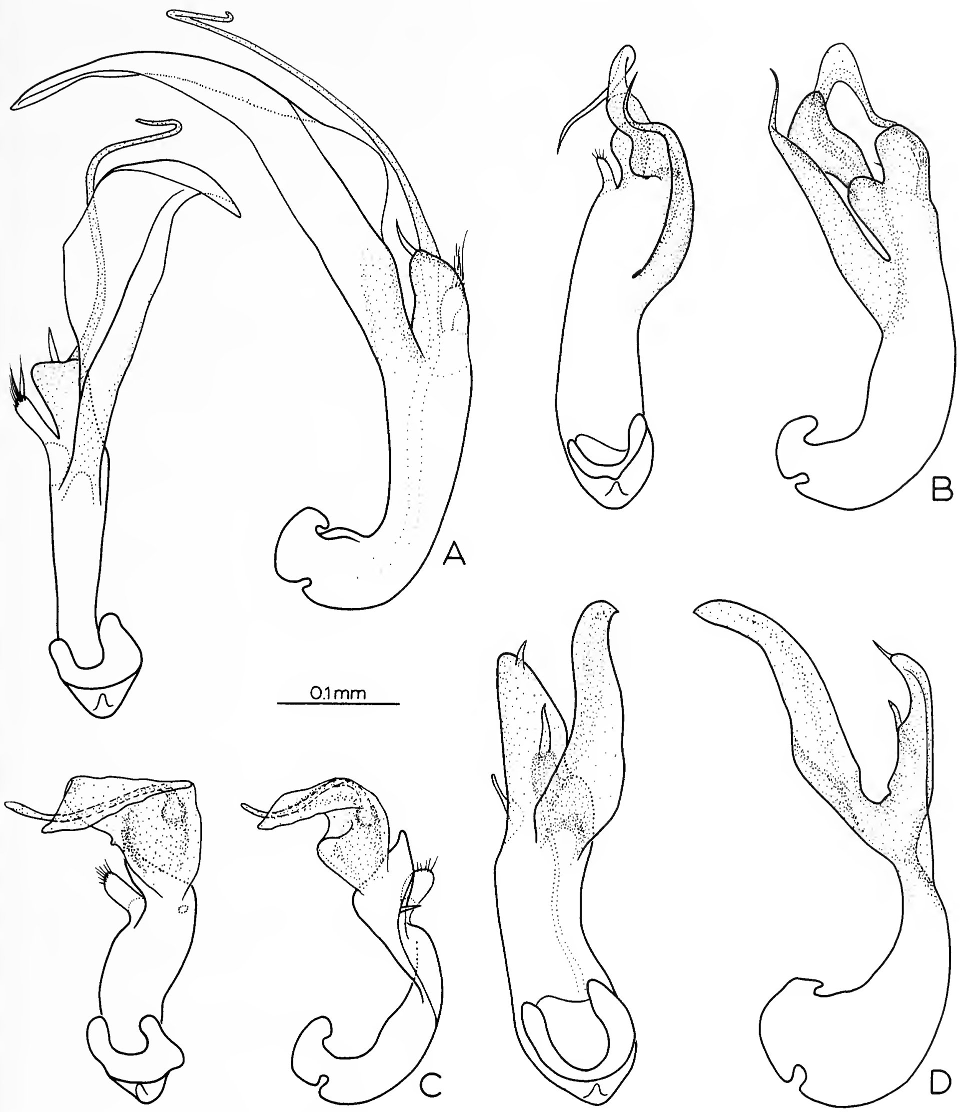
Diagnosis. – The pronotum is very distinctive, having the depressions deeper than in adults of other species. Additionally, the microreticulation of the pronotum is developed to the extreme, totaly obscuring the punctation. *P. reichardti* adults are unique among the known species of this genus in the form of the lateral fossulae, each of which is divided by an elevated region to form a deep, comparatively large depression near each pronotal angle (Fig. 15A).

Description. – *Form:* Ovate, moderately convex (Fig. 17C). *Size:* Holotype 1.74 mm long, 0.80 mm wide. *Color:* Dorsum and venter black; legs, palpi and antennae dark brown. *Head:* Length 0.38 mm; width 0.52 mm. Frons markedly microreticulate, punctation obscured, very sparsely pubescent; interocular foveae deep and large, width of each equal to distance between them; interocular tuberculi prominent; basomedial foveae absent. Frontoclypeal suture evenly arcuate. Clypeus length 0.33 width, markedly microreticulate. Labroclypeal suture slightly arcuate to rear. Labrum length 0.14 width; anterior margin arcuate in habitus view, moderately upturned. Maxillary palpomeres 2 (pseudobasal) and 4 (apical) subequal in length; palpomere 3 0.50 length of 4. Mentum trapezoidal, width at base equal length, dull, finely microreticulate, anterior margin straight. Submentum finely microreticulate. Genae swollen, dull, finely microreticulate, grooved laterally for reception of antennae. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.42 mm; maximum width (near midlength) 0.70 mm. Anterior margin deeply bisinuate. Lateral depressions convex in middle, markedly microreticulate, setae indistinct; sides crenulate, sinuate, markedly produced laterally. Lateral fossula distinctly divided by convex portion of lateral depression in form of very deep, large fovea at posterior and anterior. Pronotal disc markedly microreticulate, punctation obscured, with anterior and posterior U-shaped depression joined by extremely shallow depression; anterior U-shaped depression with distinctive, deep fovea at each anterior extreme, these foveae separated, from the anterior foveae of lateral depressions by ridge; posterior U-shaped depression with anterior extremes contiguous with posterior fovea of lateral depressions. Prosternum elevated in midline; coxae contiguous. Metasternum totally hydrofuge pubescent; middle region shallowly depressed. *Elytra:* Length 1.10 mm; maximum width (near midlength) 0.80 mm. Disc moderately shiny, with six rows of large, deep punctures between suture and humeri, rows sulcate impressed. Declivity extended through posterior 0.33. Intervals costate, width less than puncture width; each with row of decumbent setae; first interval (from suture) ending near apical 0.25. Explanate margin moderately developed ending near posterior 0.25. Apices slightly truncate. *Abdomen:* Basal four sterna with hydrofuge pubescence. Sterna 5, 6 and 7 subnitid, sparsely pubescent. *Legs:* Moderately short and stout. *Genitalia:* Male (Fig. 18A) (seven examined).

Variation. – Specimens from Santa Catarina have the pronotal depressions deeper than specimens from São Paulo. Females have the labrum emarginate anteriorly and not strongly upturned.

Natural History. – Adults have been collected in hygropetric habitats.

Distribution (Figs. 14B,162). – Presently known to be distributed in the mountains of southeastern Brazil from the state of Espirito Santo south to the state of Santa Catarina. Sixteen specimens have been studied in addition to the holotype (see Appendix A).



Figs. 18A – D, Aedeagi of *Parhydraenida* holotypes. (A) *P. reichardti*. (B) *P. hygropetrica*. (C) *P. quadraticeps*. (D) *P. lambda*.

4. *Parhydraenida lambda* new species
(Figs. 17G,18D,162)

Type-locality. – Jaguariaiva, 950 meters, Paranà, Brazil.

Type-specimen. – The holotype male (unique) is deposited in MSP. This specimen was collected by Reichardt and Martins, August 30, 1974.

Diagnosis. – The pronotum has the sides strongly arcuate posteriorly and fossulae and U-shaped depressions moderately deep. The first elytral interval continues posteriorly to near the apices. The aedeagus is highly diagnostic.

Description. – *Form:* Ovate, moderately convex (Fig. 17G). *Size:* Holotype 1.88 mm long, 0.84 mm wide. *Color:* Dorsum and venter black; legs, palpi and antennae dark brown. *Head:* Length 0.38 mm; width 0.50 mm. Frons in middle coarsely, closely punctate, microreticulation well developed in punctures, less apparent on interstices; very sparsely pubescent; interocular foveae deep and large, subrugulose, width of each nearly 0.66 distance separating them; interocular tuberculi prominent; basomedial fovea absent. Frontoclypeal suture evenly arcuate. Clypeus length slightly less than 0.50 width, punctation obscured by well developed microreticulation. Labroclypeal suture straight. Labrum length 0.33 width; anterior margin strongly upturned, arcuate in habitus view. Maxillary palpomeres 2 (pseudobasal) and 4 (apical) subequal in length; palpomere 3 0.50 length of 2. Mentum trapezoidal, width at base equal length, dull, finely punctulate, finely microreticulate, anterior margin straight. Submentum finely microreticulate. Genae swollen, shiny in midregion, dull and grooved for reception of antennae laterally. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.42 mm; maximum width (near anterior 0.33) 0.68 mm. Anterior margin bisinuate in habitus view. Lateral depressions convex, coarsely closely punctate, microreticulate within punctures, each puncture with a short but very apparent seta; sides crenulate, sinuate, moderately produced laterally. Lateral fossulae sinuate, slightly deeper at anterior and posterior than in midregion. Pronotal disc sculpture as lateral depressions, with anterior and posterior U-shaped depression; anterior U-shaped depression extended to anterior margin, shape of anterior pronotal margin trisinuate when viewed from the front; posterior U-shaped depression with "arms" terminated on disc, not connected to lateral fossulae. Posterior margin of pronotum arcuate to posterior in midregion. Prosternum elevated in midline, not carinate; coxae contiguous. Metasternum with longitudinal, oval depression in midline; this depression surrounded by non-pubescent area, (but I believe the hydrofuge hairs are usually present here, being abraded in holotype). *Elytra:* Length 1.14 mm; maximum width (near midlength) 0.84 mm. Disc shallowly depressed in middle, shiny, with six rows of large, deep punctures between suture and humeri, rows deeply sulcate impressed. Origin of declivity near posterior 0.33. Intervals subcostate, width less than puncture width, each with row of decumbent setae; first interval (from suture) extended to apices. Explanate margin well developed, terminated near posterior 0.17. Apices rounded. *Abdomen:* Basal four sterna with hydrofuge pubescence (some abraded). Sternum 5 pubescent in anterior 0.25, remainder shiny. Sterna 6 and 7 shiny, sparsely pubescent. *Legs:* Moderately short and stout. *Genitalia:* Male (Fig. 18D) (one examined).

Natural History. – Hans Reichardt (*in litt.*) gives the following information concerning the type locality: "in typical hygropetric habitat, collected together with different species of Torridincolidae, genus *Ytu*".

Distribution. (Fig. 162). – Known only from the type locality at Jaguariaiva in the state of Paranà, Brazil.

Etymology. – The aedeagus resembles the Greek letter lambda.

5. *Parhydraenida effeminata* J. Balfour-Browne
(Figs. 14B,17E,162)

Parhydraenida effeminata J. Balfour-Browne, 1975:43 (holotype female deposited in MSP; type locality: Nova Petropolis, Rio Grande do Sul, Brazil).

Diagnosis. – The pronotum is comparatively shiny, with fossulae and U-shaped depressions extremely shallow, especially the barely perceptible posterior U-shaped depression. The first elytral interval is extended the full length of the elytron. The body form is rather distinctive, as a comparison between the illustrations will reveal (Fig. 17E).

Description. – *Form:* Ovate, moderately convex (Fig. 14B). *Size:* Holotype 1.84 mm long, 0.82 mm wide. *Color:* Dorsum and venter black; legs, palpi and antennae light brown. *Head:* Length 0.38 mm; width 0.54 mm. Frons in middle moderately coarsely, closely punctate, punctures microreticulate, interstices obsoletely so; sparsely pubescent; interocular

Fig. 19. Aedeagus of *Parhydraenida bubrunipes*, holotype.

foveae shallow and broad, width of each equal to intervening distance; interocular tuberculi not prominent; basomedial fovea absent. Frontoclypeal suture evenly arcuate. Clypeus width 2.5 times length, sides convergent, sculpture as middle of frons. Labroclypeal suture straight. Labrum length 0.33 width; anterior angles rounded; middle of anterior margin narrowly, moderately deeply emarginate. Maxillary palpomere 4 (apical) wider than a tarsal apex, slightly longer than palpomere 2 (pseudobasal); palpomere 3 slightly less than 0.50 length of 4. Mentum trapezoidal, width at base equal length, microreticulate, dull, anterior margin straight. Submentum evenly, finely punctulate. Genae swollen, dull, finely punctulate, grooved laterally for reception of antennae. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40; maximum width (near anterior 0.33) 0.66 mm. Anterior margin bisinuate. Lateral depressions deflexed slightly at anterior angles, not convex, moderately coarsely, very closely punctate, each puncture with short but very apparent seta;

strongly microreticulate in punctures, interstices shiny, very obsoletely microreticulate; sides crenulate, sinuate, not markedly produced laterally. Lateral fossulae sinuate, shallow for entire length. Pronotal disc sculptured as lateral depressions, with very shallow anterior and posterior U-shaped depression, latter nearly imperceptible; anterior U-shaped depression deepest and well marked at anterior margin. Posterior margin very slightly arcuate to rear in midregion. Prosternum slightly elevated in midline, not carinate; coxae contiguous. Metasternum entirely hydrofuge pubescent, depressed in midregion. *Elytra:* Length 1.16 mm; maximum width (near midlength) 0.82 mm. Disc shiny, with six rows of large, deep punctures between suture and humeri, rows very shallowly sulcate impressed. Declivity beginning near posterior 0.33. Intervals subcostate, width less than puncture width; each with row of decumbent setae; first interval (from suture) extended to apices. Explanate margin moderately developed. Apices very slightly dehiscent at suture. *Abdomen:* Basal four sterna with hydrofuge pubescence. Sternum 5 hydrofuge pubescent in anterior 0.25, remainder shiny. Sternum 6 shiny, posterior margin strongly arcuate to front, sparsely pubescent. Sternum 7 ovate, shiny, sparsely pubescent. *Legs:* Moderately short and stout. *Genitalia:* Male unknown.

Distribution. (Figs. 14B, 162). – Presently known from the states of Rio Grande do Sul and Santa Catarina, Brazil. Refer to J. Balfour-Browne (1975) for locality data.

6. *Parhydraenida paralonga* new species
(Figs. 17D, 20A,162)

Type-locality. – Campos do Jordao, 1650 meters, Sâo Paulo, Brazil.

Type-specimens. – The holotype male and allotype with identical data are deposited in MSP. Paratypes from the same locality, all females, are deposited in MSP (15), USNM (2) and PDP (2). These specimens were collected by Hans and Bartyra Reichardt, January, 1976.

Diagnosis. – Adults are quite similar externally to those of *P. hygropetrica* in that both groups have the first elytral interval ending at the posterior 0.25. Additionally, pronota of both groups have dull reliefs and rather shallow depressions. *P. paralonga* adults differ in larger size (ca. 1.75 vs. 1.55 mm long), body form (Figs. 17D,F), more deeply sulcate impressed elytra and aedeagal form (Figs. 18B,20A).

Description. – *Form:* Ovate, moderately convex (Fig. 17D). *Size:* Holotype 1.72 mm long, 0.76 mm wide. *Color* Dorsum and venter black; legs, palpi and antennae dark brown. *Head:* Length 0.34 mm; width 0.48 mm. Frons in middle coarsely punctate, markedly microreticulate, very sparsely pubescent; interocular foveae deep, subrugulose, width of each nearly 0.50 distance separating them; interocular tuberculi prominent; basomedial fovea absent. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, markedly microreticulate, sides convergent. Labroclypeal suture straight. Labrum length 0.33 width; anterior margin moderately upturned, arcuate in habitus view. Maxillary palpomere 2 (pseudobasal) and 4 (apical) subequal in length: palpomere 4 swollen; palpomere 3 0.50 length of 2. Mentum trapezoidal, dull, finely microreticulate; anterior margin straight. Submentum evenly, finely punctulate, punctures contiguous. Genae swollen, dull, finely punctulate, grooved laterally for reception of antennae. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near anterior 0.33) 0.64 mm. Anterior margin bisinuate. Lateral depressions slightly convex, coarsely punctate, markedly microreticulate; sides slightly crenulate, sinuate not markedly produced laterally. Lateral fossulae slightly sinuate, posterior 0.50 slightly deeper than remainder. Pronotal disc sculptured as lateral depressions, with posterior and anterior U-shaped depression; anterior U-shaped depression wider than posterior, extended to anterior margin, deepest near margin; posterior U-shaped depression with "arms" terminated on disc not extended to lateral fossulae. Posterior margin arcuate to rear in midregion. Prosternum elevated in midline, not carinate; coxae contiguous. Metasternum entirely pubescent, depressed in midregion. *Elytra:* Length 1.08 mm; maximum width (near midlength) 0.76 mm. Disc moderately dull, with six rows of large deep punctures between suture and humeri, rows deeply sulcate impressed. Declivity not well defined. Intervals subcostate, width less than puncture width; first interval (from suture) ended near apical 0.25. Explanate margin moderately developed, ending near apical 0.20. Apices slightly truncate. *Abdomen:* Basal four sterna with hydrofuge pubescence. Sternum 5 hydrofuge pubescence in anterior 0.25, remainder shiny. Sterna 6 and 7 shiny, sparsely pubescent. *Legs:* All legs moderately short and stout. *Genitalia:* Male (Fig. 20A) (one examined).

Variation. – Females have the labrum emarginate and not strongly upturned.

Distribution. – (Fig. 162) Known only from the type-locality at Campos do Jordao in the state of São Paulo, Brazil.

Etymology. – Latin, *para* (beside) plus *longa* (long). This name refers to the single long paramere of the aedeagus.

7. *Parhydraenida alida* J. Balfour-Browne (Figs. 12B,20B,162)

Parhydraenida alida J. Balfour-Browne, 1975: 40. (holotype male deposited in MSP; type-locality: Barra da Tejuca, Rio de Janeiro, Guanabara, Brazil).

Diagnosis. – Combination of small size (about 1.46 mm long), shiny, non-microreticulate pronotal reliefs, first elytral interval terminated near the posterior 0.25, and aedeagal form serve as diagnostic characteristics. Similarities in aedeagal structure (Figs. 18B, 20B) and body size and form (Figs. 12B,17F) indicate that *P. alida* and *P. hygropetrica* form a sister-species pair. Adults of the two species are differentiated externally by the pronotal reliefs, which are non-microreticulate and shiny in *P. alida* specimens; dull and microreticulate in *P. hygropetrica* specimens.

Description. – *Form:* Ovate, moderately convex (Fig. 12B). *Size:* Holotype 1.46 mm long, 0.64 mm wide. *Color* Dorsum and venter black; legs, palpi and antennae brown. *Head:* Length 0.30 mm; width 0.42 mm. Frons in middle moderately coarsely punctate, microreticulate in punctures, interstices obsoletely so, moderately shiny; very sparsely pubescent; interocular foveae strongly microreticulate, deep and large, width of each nearly 0.66 distance separating them; interocular tuberculi prominent; basomedial fovea absent. Frontoclypeal suture evenly arcuate. Clypeus length 0.33 basal width, sides convergent, microreticulate, punctures somewhat obscured. Labroclypeal suture straight. Labrum length 0.25 width; anterior border shallowly emarginate, strongly upturned. Maxillary palpomere 2 (pseudobasal) and 4 (apical) subequal in length; palpomere 3 0.50 length of 2. Mentum trapezoidal, width at base equal length, finely microreticulate, anterior margin straight. Submentum finely microreticulate. Genae swollen, dull, finely microreticulate, grooved laterally for reception of antennae. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (near anterior 0.33) 0.54 mm. Anterior margin slightly bisinuate. Lateral depressions with edges rounded but remainder not convex, with short but very apparent setae; sides crenulate, sinuate, not markedly produced laterally. Lateral fossulae much broader in anterior than posterior, shining, finely microreticulate, setae much less apparent than those of lateral depressions. Pronotal disc with well developed anterior and posterior U-shaped depressions, anterior broadest and extended to anterior margin; posterior U-shaped depression ended on disc, not connected to lateral fossulae. Posterior margin arcuate to rear in midregion. Prosternum elevated in midline, not carinate; coxae contiguous. Metasternum entirely hydrofuge pubescent, median region depressed. *Elytra:* Length 0.88 mm; maximum width (near midlength) 0.64 mm. Disc moderately shiny, with six rows of moderately large, deep punctures between suture and humeri, rows sulcate impressed. Origin of declivity near posterior 0.33. Intervals subcostate, width slightly less than puncture width; each with row of decumbent setae; first interval (from suture) terminated at apical 0.25. Explanate margin moderately developed. Apices slightly truncate. *Abdomen:* Basal four sterna plus anterior 0.33 of sternum 5 hydrofuge pubescent. Posterior 0.66 of sterna 5 and 6 subnitid, sparsely pubescent. *Legs:* Relatively stout. *Genitalia:* Male (Fig. 20B) (one examined).

Variation. – The labrum is more deeply emarginate in females, the edge of the emargination being upturned slightly. Maxillary palpomere 4 is larger in males, the lateral surface more arcuate, the medial sinuate; in females the medial is slightly arcuate.

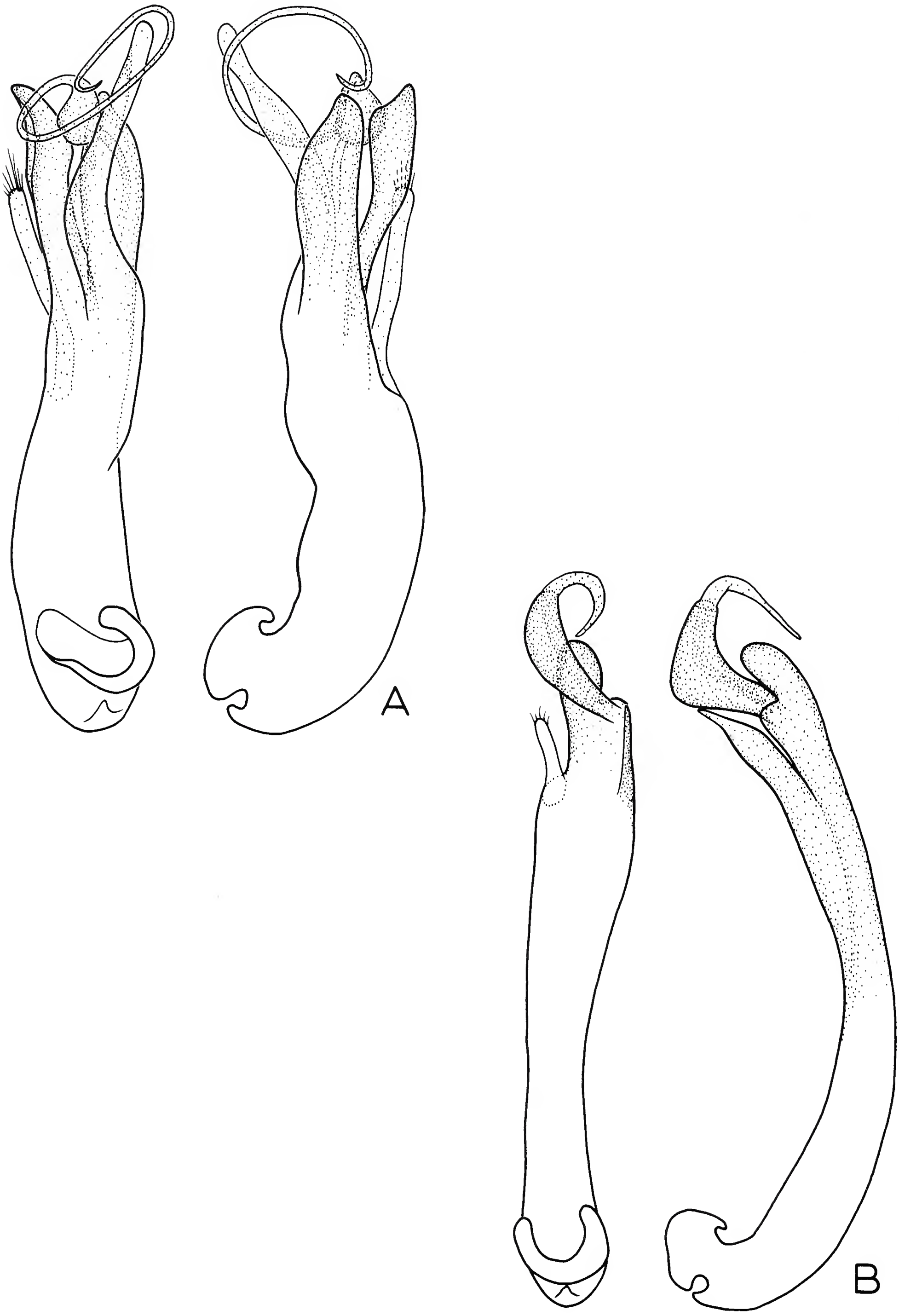
Distribution. – (Fig. 162) Presently known only from the state of Rio de Janeiro, Brazil.

8. *Parahydraenida hygropetrica* new species (Figs. 17F,18B,162)

Type-locality. – Santa Teresa, Espirito Santo, Brazil.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in MSP. These specimens and four paratypes from the same locality (two MSP; one USNM; one PDP) were collected by S. Vanin and O. Flint, April 23, 1977.

Diagnosis. – Small size (about 1.55 mm long), dull, microreticulate pronotal reliefs, first elytral interval ending near posterior 0.25, and aedeagal form (Fig. 18B) serve as diagnostic characteristics. The pronotal microreticulation is similar to that of *P. paralonga* adults; refer to the diagnosis of that species for further comments. Body form and size plus aedeagal structure indicate that *P. hygropetrica* and *P. alida* are sister-species. The pronotal reliefs of *P. alida* adults, however, are shiny, non-microreticulate.



Figs. 20A – B, Aedeagi of *Parhydraenida* holotypes. (A) *P. paralonga*. (B) *P. alida*.

Description. – *Form:* Ovate, moderately convex (Fig. 17F). *Size:* Holotype 1.52 mm long, 0.68 mm wide. *Color:* Dorsum and venter black; legs, palpi and antennae dark brown. *Head:* Length 0.30 mm; width 0.44 mm. Frons microreticulate, moderately coarsely punctate, punctures obscured by microreticulation, very sparsely pubescent; interocular foveae deep and large, width of each nearly 0.66 distance separating them; interocular tuberculi prominent; basomedial fovea absent. Frontoclypeal suture evenly arcuate. Clypeus length 0.33 width, microreticulate, sides convergent. Labroclypeal suture straight. Labrum length 0.25 width; anterior margin upturned, arcuate in habitus view. Maxillary palpomere 4 slightly swollen, slightly longer than palpomere 2; palpomere 3 shorter than 2. Mentum trapezoidal, width at base equal length, shining, very finely microreticulate, anterior margin straight. Submentum shiny, finely punctulate. Genae swollen, very shiny in midregion, dull and microreticulate laterally; grooved laterally for reception of antennae. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (near anterior 0.33) 0.56 mm. Anterior margin very shallowly bisinuate. Lateral depressions very slightly convex, microreticulate, coarsely closely punctate; sides crenulate, sinuate, moderately produced laterally. Lateral fossulae slightly sinuate, of equal depth along entire length. Pronotal disc microreticulate, moderately coarsely, closely punctate, with anterior and posterior U-shaped depression; anterior U-shaped depression extended to anterior margin; posterior U-shaped depression with "arms" ended on disc, not connected to lateral fossulae. Posterior margin of pronotum arcuate posteriorly in midregion. Prosternum elevated in midregion; coxae contiguous. Metasternum entirely hydrofuge pubescent; midline with narrow groove. *Elytra:* Length 0.88 mm; maximum width (near midlength) 0.68 mm. Disc moderately flat, shiny, with six rows of large, deep punctures between suture and humeri, rows shallowly sulcate impressed. Declivity origin near posterior 0.33. Intervals subcostate, width less than puncture width; each with row of decumbent setae; first interval(from suture) ended at apical 0.25. Explanate margin moderately developed, ended near posterior 0.17. Apices rather broad, arcuate. *Abdomen:* Basal four sterna with hydrofuge pubescence. Sternum 5 pubescent in anterior 0.25, remainder shiny. Sterna 6 and 7 shiny, moderately produced posteriorly. *Legs:* Moderately short and stout. *Genitalia:* Male (Fig. 18B) (five examined).

Variation. – The labrum is emarginate and not markedly upturned in females. Other sexual dimorphism includes size and shape of maxillary palpomere 4. In males this article is longer and wider than in females; the width being greater than the apical width of the last tarsomere in males, less than this width in females.

Natural History. – The type-series were collected from a hygropetric habitat.

Distribution. – (Fig. 162). Known only from the type-locality at Santa Teresa in the State of Espirito Santo, Brazil.

Etymology. – Latin, *hygro* (wet) plus *petrus* (rock).

9. *Parhydraenida pentatenkta* new species
(Figs. 17B,50A,162)

Type-locality. – 38 km E. of Portoviejo, Manabi Province, Ecuador.

Type-specimen. – The holotype female (unique) is deposited in USNM. This specimen was collected by P. Spangler, A. Langley and J. Cohen, May 11, 1975.

Diagnosis. – Adults of this species are unique in reduction of hydrofuge pubescence of the abdomen to the first two sterna plus the anterior 0.33 of sterna 3. The remaining sterna are shiny and with very sparse, non-hydrofuge hairs. Adults of all other currently known species in the genus *Parhydraenida* have the first four sterna plus the anterior portion of sternum 5 hydrofuge pubescent. *P. pentatenkta* adults are also quite distinctive dorsally, as the pronotum is comparatively large and quite transverse (Fig. 17B). The deflexed anterior clypeal angles and labrum are worthy of note.

Description. – *Form:* Ovate, moderately convex (Fig. 17B). *Size:* Holotype 1.56 mm long, 0.80 mm wide. *Color:* Brown. *Head:* Length 0.30 mm; width 0.54 mm. Frons rugulose, strongly microreticulate, very sparsely pubescent; interocular foveae deep and large, width of each nearly equal distance separating them; interocular tuberculi prominent; basomedial fovea very slightly apparent. Frontoclypeal suture evenly arcuate. Clypeus length 0.33 width, finely rugulose, moderately pubescent, anterior angles deflexed. Labroclypeal suture straight in habitus view; viewed anteriorly it is arcuate due to deflexed anterior angles of clypeus. Labrum length 0.33 width; very markedly deflexed, nearly at right angle to major plane of clypeus; anterior margin emarginate and prominently pubescent. Maxillary palpus very short; palpomeres 2 and 4 subequal in length, palpomere 3 0.50 length of 2. Mentum markedly punctulate, pubescent. Submentum punctulate. Genae swollen, dull, punctulate, grooved laterally for reception of antennae. Postgena punctulate. *Thorax:* Pronotum length at midline 0.42 mm; maximum width (near anterior 0.33) 0.76 mm. Anterior margin bisinuate,

anterior angles produced. Lateral depressions broad, very slightly convex, rugulose; sides crenulate, very slightly sinuate at posterior, moderately produced laterally. Lateral fossulae slightly deeper at anterior and posterior than in midregion. Pronotal disc rugulose, with anterior and posterior U-shaped depression connected by narrow median groove. Posterior margin arcuate to rear in midregion. Prosternum slightly elevated in midregion. Metasternum hydrofuge pubescent; longitudinally depressed in middle. *Elytra:* Length 1.04 mm; maximum width (near midlength) 0.80 mm. Disc dull, with six rows of large, deep punctures between suture and humeri, rows deeply sulcate impressed. Declivity origin near posterior 0.33. Intervals costate, width less than puncture width; each with row of decumbent setae; first interval (from suture) ended near posterior 0.20. Explanate margin moderately developed, markedly serrate in anterior 0.20. Apices slightly truncate. *Abdomen:* Basal two sterna plus anterior 0.33 of sternum 3 hydrofuge pubescence, remainder shiny, very sparsely pubescent. *Legs:* Short and stout. *Genitalia:* Male unknown.

Natural History. – The following label description accompanies the holotype: "collected in splash zone at waterfall".

Distribution. – (Fig. 50A) Known only from the type-locality near Portoviejo in western Ecuador.

Etymology. – Greek, *penta* (five) plus *tenkta* (wettable). This name refers to the five abdominal sterna which lack hydrofuge pubescence and are, therefore, wettable.

GENUS *HYDRAENA* KUGELANN

Hydraena Kugelann 1794:579 (type-species: *Hydraena riparia* Kugelann 1794:579). – d'Orchymont, 1916:96. – d'Orchymont, 1923:33. – Knisch, 1924:33. – F. Balfour-Browne, 1958:178. – Janssens, 1965).

Discussion. – *Hydraena* is markedly diverse, the total number of species described for the world being about 400, of which 95 are now known for the Western Hemisphere. It is the most diverse genus in the family, *Ochthebius* being second, with about 300 species. Judging from the number of new species described in this paper and those by Janssens (1965, 1972) and Zwick (1977), one must suppose that the actual number of *Hydraena* species is considerably greater than the present figure.

Members of *Hydraena* are on all continents, but are notably absent from New Zealand (d'Orchymont, 1936a), where they are apparently replaced by members of *Orchymontia* Broun 1919 (d'Orchymont 1936a; Zwick, 1975). In the Western Hemisphere, *Hydraena* members are in most areas, being absent from Alaska, the Great Plains region of the United States, Chile, Uruguay, and all of Argentina except extreme northernmost (Fig. 160).

Current data indicate that the greatest concentration of species is in California and Mexico-Central America, but more field work remains to be done, especially in South America. Distributional considerations are discussed in more detail in the section on zoogeography.

During the 1800's, students of the genus organized the species into a number of subgenera, based in large part upon rather insignificant and unstable characteristics. Consequently, most of these subgenera have been found to be of species-group rank when studied rigorously.

Rey (1884) was the first worker to use the number of elytral striae between the suture and humeral callus as a means of subgeneric separation. Species with more than six striae (usually 10) he placed in *Hydraena (sensu stricto)*, whereas those with six were placed into his subgenera *Haenydra* or *Hadrenya*, depending upon shape of metasternal plaques.

Kuwert (1888) erected the subgenera *Taenhydraena, Phothydraena, Hoplydraena, Holcohydraena, Sphaenhydraena* and *Grammhydraena.* These names were either new for groups already proposed by Rey (F. Balfour-Browne, 1958), or the groups were based upon insignificant features.

D'Orchymont (1930) was the first to discover that aedeagi of males of species with six elytral striae lacked parameres, whereas males of species with more than six striae had

parameres. On this basis he accepted Rey's (1884) *Hydraena (sensu stricto)* (with parameres) and *Haenydra* (lacking parameres). He also recognized Kuwert's (1888) subgenus *Phothydraena*, which was erected for the single species *H. testacea* because of the unusually large punctures at the margin of the elytron in adults. This appears to be inconsistent, as the aedeagus and elytral striae of *H. testacea* clearly place it in *Hydraena (sensu stricto)*.

In a paper on the phylogeny of *Hydraena*, d'Orchymont (1936a) tabulated those characters which he deemed significant, and recognized the subgenera *Hydraena (sensu stricto)*, *Holcohydraena, Taenhydraena, Phothydraena* and *Haenydra*.

Kuwert (1888) erected *Holcohydraena* for *Hydraena rugosa* Mulsant 1884, of Europe and the Iberian Peninsula, because of lack of metasternal plaques. Adults of some species of New World *Hydraena* also lack plaques, but these species are related to others from this geographical area whose adults have plaques. Plaque loss occurs in species which are of different lineages and is obviously not of subgeneric significance. Zwick (1977) has found the same to be true for Australian *Hydraena*.

Kuwert's (1888) *Taenhydraena*, which contains only *Hydraena exarata* Kiesenwetter 1865 of the Iberian Peninsula, was established because of the elevated alternate elytral intervals of adults of that species. Adults of *Hydraena alternata* from Mexico also have this trait, but this species is probably of a different lineage, the similarities of the two being convergent. Aedeagi of *H. exarata* males (d'Orchymont, 1936b) do not indicate any obvious relationship to *H. alternata*. Further study is needed here, but I suspect that the characteristics upon which *Taenhydraena* is based will eventually be considered of only species-group significance.

More recently, Janssens (1972), in a paper describing one new species from Vietnam, two from Ghana, and one from Paraguay, has proposed a new genus, which he names *Hydraenopsis*. The principal basis for this proposed taxon is form of the aedeagus, more specifically, location of the insertion of the parameres. He states, "Parmi ces caracteres, l'un m'a paru suffisant pour creer une coupe generique groupant la majorite des especes intertropicales connues et prenant le nom d'*Hydraenopsis* n. g. Il s'agit de la structure des genitalia: au lieu d'etre attaches a la base, les parameres du nouveau genre, plus courtes que chez *Hydraena (sensu stricto)*, sont attaches au centre du corps basal, ainsi qu'on le verra dans les figures 2, 4 et 5."

Emphasizing form of the aedeagus further, he states, "....le caractere determinant pour conclure a la validite du nouveau genre *Hydraenopsis* reside dans la structure tres particulere des genitalia et notamment dan la mode d'insertion de parameres."

I have found during this study that insertion of the parameres varies greatly from species to species in the Neotropical fauna, and virtually all intermediate types are seen between those whose males have parameres inserted at the base and those whose males have parameres near the apex. For instance, one could cite the following species as examples in a sequence of from base to apex insertion: *chiapa – scintillabella – alternata – maureenae – orcula – colymba – youngi – paeminosa*.

Further, males of several species have one paramere closer to the base than the other, some examples being *trinidensis, turrialba, spangleri* and *browni*. Clearly, this great variation of paramere insertion precludes using this character for generic separation.

The following external characteristics were cited by Janssens (1972) as significant, "....la form du pronotum et l'article apical des palpes maxillaires toujours depourvu de noircessement a l'apex sont des caracteres dont la constance corrobore la stabilite du nouveau genre qu'on reconnaitra ainsi assez commodement a premiere vue." These characteristics are also highly

variable within neotropical *Hydraena*, even within the aggregate of species herein presented as the *leechi* Group.

Consequently, I do not recognize *Hydraenopsis* Janssens as a valid genus, and consider all of the *Hydraena* in the Western Hemisphere as members of *Hydraena (sensu stricto)*. However, relative ranking of primarily temperate vs. primarily tropical components of *Hydraena* would require additional thought if and when constant differentiating characteristics were elucidated.

Relative to amount of published data regarding Palearctic *Hydraena*, available information on New World forms is scant indeed. This is due in large part to the lack of material available to earlier workers such as d'Orchymont who, in 1923, had only about 100 specimens representing the nine species known at that time. Through the efforts of recent American students of aquatic Coleoptera, most notably Hugh B. Leech and Paul J. Spangler, specimens have gradually accumulated in collections; as a result of these efforts, more than 10,000 specimens were available for this study.

Publications concerning Western Hemisphere *Hydraena* began with Kiesenwetter's description of *H. pennsylvanica* and *H. marginicollis* in 1849. Subsequent to that work, 16 taxa have been described in the following sequence: *H. punctata* LeConte 1855; *H. longicollis*, *H. puncticollis*, *H. sordida* Sharp, all 1882; *H. angulicollis* Notman 1921; *H. grouvellei*, *H. sahlbergi*, *H. germaini*, *H. vandykei*, *H. guadelupensis*, all d'Orchymont 1923; *Hydraena needhami* d'Orchymont 1929; *H. plaumanni* d'Orchymont 1937; *H. insularis* d'Orchymont 1945; *Hydraena vandykei niger* Hatch 1965; *H. paraguayensis* Janssens 1972.

Despite relatively few descriptions, attempts to obtain types did not meet with complete success. Although a number of European museums were contacted, Kiesenwetter's types of *H. pennsylvanica* and *H. marginicollis* were not found. D'Orchymont (1945), despite his extensive knowledge of the genus, was apparently unable to find the type of *H. marginicollis* as he based his concept of the species upon a specimen in the Institut royal des Sciences Naturelles de Belgique collection labelled "cotype?" of *H. marginicollis*. The above suggests that the types of *H. marginicollis* have been destroyed or irrevocably lost. However, combination of small size and type locality ("Westindien" and New Orleans) leave little doubt as to the identify of *H. marginicollis*. To firmly establish the identity of *H. marginicollis* a neotype is designated herein. Likewise, I believe that the single type-specimen of *H. pennsylvanica* has reached a similar fate; therefore a neotype is designated to insure stability.

Efforts to obtain holotypes of d'Orchymont's *H. insularis*, *H. grouvellei* and *H. germaini* also failed. However, paratypes of each of thse species have been studied and there is no confusion concerning their identities. I believe that futher search at European museums (where I have already enquired) will result in location of these holotypes, therefore no lectotypes are designated for these species.

The type series of Sharp's Neotropical species *H. longicollis*, *H. puncticollis*, and *H. sordida* have been studied and lectotypes are designated for each.

Holotypes of the following species have been seen: *H. sahlbergi* d'Orchymont; ; *H. plaumanni* d'Orchymont; *H. guadelupensis* d'Orchymont; ; *H. punctata* LeConte; *H. angulicollis* Notman; *H. needhami* d'Orchymont; *H. vandykei* d'Orchymont; *H. vandykei niger* Hatch.

The holotype and two paratypes of *H. paraguayensis* Janssens were requested from the Institut royal des Sciences Naturelles de Belgique (through E. Janssens). However, when the material was received, it was found to contain the pin with holotype label and locality label, but the specimen was no longer glued to the card. A search of the box proved fruitless. Therefore, a

lectotype is herein designated.

Of the 18 previously described species, only one instance of new synonomy was encountered. *H. needhami* d'Orchymont 1929 was found to be conspecific with *H. punctata* 1855.

Pronotal features. – The major relief features of *Hydraena* pronota (Fig. 21C) consist of anteroexternal foveolae (AEF), margins (M), posteroexternal foveolae (PEF) and posterointernal fovelae (PIF). In adults of certain species, such as *H. circulata* (Fig. 21C), the antero- and posteroexternal foveolae are markedly confluent and form a longitudinal depression similar to the "lateral fossulae" of *Ochthebius* (Fig. 98A). In adults of other species, such as *H. bituberculata* (Fig. 31C) and *H. cuspidicollis* (Fig. 48C), the antero- and posteroexternal foveolae are distinct, although joined by a shallow depression. In adults of species of the *marginicollis* Group, most pronotal depressions are obsolete, only the anteroexternal foveolae being apparent (e.g. *marginicollis*, (Fig. 54C)).

Diagnosis. – Elongate maxillary palpi (Fig. 148C) readily distinguish *Hydraena* adults from those of all other Western Hemisphere Hydraenidae except *Spanglerina*. From *Spanglerina* adults, *Hydraena* adults are distinguished by 1) the less markedly angulate pronotum (cf. Figs. 21C,54C,65E), which lacks a median ridge or anterointernal foveolae, 2) absence of foveae near the anterior margin of the labrum (cf. Figs. 54D,65F), 3) procoxae not as widely separated as mesocoxae (cf. Figs. 21D,E,65D), 4) without metacoxae widely separated (cf. Figs. 21D,65C), and 5) males with aedeagus of a different basic plan (cf. Figs. 22A,45A,67A-D).

Description. – *Form:* Generally elongate and relatively depressed, adults of a few species elongate-oval. *Size:* Length about 1.00-2.00 mm, width about 0.47-0.85 mm, Females generally larger than males. *Color:* Adults of some species black, some brown, a few with testaceous or ochraceous legs contrasted with darker body color, many with black pronotal fascia or macula bordered by testaceous area. *Head:* Very finely, sparsely punctate to coarsely punctate, adults of many species with well developed microreticulation. Interocular fovea and interocular tuberculi (ocelli) absent. Clypeus transverse, sides convergent anteriorly. Labrum bilobed, without apparent sexual dimorphism. Maxillary palpus elongate, palpomere 2 generally as long as 3 and 4 combined. Mentum generally very slightly longer than wide, finely microreticulate or punctulate. Genae smooth or with a posterior ridge. Antennae of nine articles (4+5). *Thorax:* Pronotum with sides slightly to moderately produced at middle, denticulate; anterior angles produced in one species only. Lateral areas of pronotum with more or less developed anteroexternal foveolae, posteroexternal foveolae in many adults also. Disc with posterointernal foveolae present or absent; anterior region of many adults with shallow transverse depression. Sculpture of disc varied from extremely finely sparsely punctate to coarsely punctate and with microreticulate interstices. Prosternum of most adults with coxae separated by thin carina, of few adults separated from carina by thin shelf. Mesosternum of most adults with internal and external carinae divergent from anterior to posterior; intercoxal process of most adults quite narrow, few adults as wide as long; apex varied from blunt to acute, of few adults elevated to form ridge contiguous with same on metasternum. Metasternum with glabrous plaques present or absent; plaques of various shapes including elongate, oval, totally carinate, carinate at lateral extremes and arcute. *Elytra:* Most adults with 10 rows of punctures between suture and humeral callus, few adults with punctures random on disc or on entire elytron. Intervals varied from flat to subcarinate, in few adults with alternate intervals elevated. Explanate margin very narrow to broad. Elytral apices, in posterior aspect, in most adults turned upward in form of angle with one another; in few adults, angles not formed. *Abdomen:* Intercoxal segment flat or concave. First four sterna and anterior region of 5 with hydrofuge pubescence. Posterior region of sterna 5 very sparsely pubescent in males, with relatively long setae in females. Sternum 6 sparsely pubescent. Apical sternum (actual tenth) retracted in some adults. *Legs:* Protarsi without obvious expanded pads of suction setae. Protibiae of many adults enlarged or excavate near apex. Mesotarsi with symmetrical claws except for adults of one species. Mesotibiae straight in most, arcuate in few adults. Metatibiae varied from slender to markedly enlarged, adults of some species with brush of hairs, prominent spines, or tubercles. *Genitalia:* Aedeagus varied markedly, paramere insertion varied from at base to near apex. Paramere shape varied from slender to lobate, males of few species with one paramere bifid. Right paramere of most males larger than left, but not in form of cup into which remainder of aedeagus rests. Central portion of aedeagus varied from slender to nearly oval. Apex of few males with flagellum.

Key to the groups of Western Hemisphere *Hydraena*

1 (0) Posterior ridge of genae well developed (Fig. 21H); intercoxal segment of abdomen concave, with posterior margin markedly arcuate (Fig. 21D); scintilla absent 2

1′ Posterior ridge of genae absent (Figs. 48E,54D,57A,63G) or nearly imperceptible; intercoxal segment flat, with posterior margin straight or weakly arcuate (Figs. 48D,57B,63A,B); scintilla present or absent 3

2 (1) Pronotum widest near midlength (Fig. 21C); elytral punctures serial or, in few adults, with few random punctures on disc (Figs. 21A,G); prosternal carina not produced anteriorly into a short spine, or very weakly so (Fig. 21E); species from Canada and the United States . . . . *circulata* Group, p. 72

2′ Pronotum widest before midlength; elytral punctures entirely random on disc; prosternal carina produced anteriorly into a short spine; one species from Surinam . . . . *paeminosa* Group, p. 210

3 (1′) Pronotum with posterointernal foveolae; scintilla present or absent (Figs. 31C,32B,48C) . . . . *leechi* Group, p. 102

3′ Pronotum without posterointernal foveolae (Figs. 54A,C); scintilla absent . . . . *marginicollis* Group, p. 164

Key to *circulata* Group species of Western Hemisphere *Hydraena*

1 (0) Meso- and metatibiae arcuate . . . . *H. quadricurvipes*, new species p. 93

1′ Meso- and metatibae not arcuate 2

2 (1) Elytral disc with some random punctures 3

2′ (1) Elytral disc with punctures in series 4

3 (2) Plaques arcuate, separated by twice plaque width; Appalachian Mountains . . . . *H. appalachicola*, new species, p. 83

3′ Plaques straight, separated by plaque width; Lake County, California . . . . *H. mignymixys*, new species, p. 92

4 (2′) Species from eastern United States and adjacent Canada (including *angulicollis* Notman, see distribution map, (Fig. 25A) 5

4′ Species from western United States and adjacent Canada 8

5 (4) Pronotum with dark brown macula on disc, not extended into lateral depressed areas; aedeagus as illustrated (Fig. 26B) . . . . . . *H. atlantica*, new species, p. 85

5′ Pronotum dark brown except for narrow brownish or testaceous border; aedeagus otherwise 6

6 (5′) Elytral intervals not elevated; plaques separated anteriorly by more than plaque width; pronotal punctation more widely separated; average size smaller; aedeagus as illustrated (Fig. 24D) . . . . *H. angulicollis* Notman, p. 82

6′ Elytral intervals slightly elevated; plaques separated anteriorly by plaque width; pronotal punctation more closely spaced; average size larger; aedeagus otherwise 7

7 (6′) Plaques separated posteriorly by plaque width; aedeagus as illustrated (Fig. 29B). . . . . *H. ancylis*, new species, p. 99

7′ Plaques separated posteriorly by less than plaque width; aedeagus as illustrated (Fig. 29A) . . . . *H. pennsylvanica* Kiesenwetter, p. 96

8 (4′) Plaques elevated, carinate at posterior in most specimens, separated at posterior by about four times plaque width or more; black; aedeagus as illustrated (Fig. 29D) . . . . *H. nigra* Hatch, p. 84

8′ Plaques not elevated, separated by twice plaque width, or less; black or brownish 9

9 (8′) Body form broad, 1.78 mm x 0.88 mm; legs short, stout; palpi relatively short; aedeagus as illustrated (Fig. 28A); Yosemite Falls, California . . . . *H. yosemitensis*, new species, p. 94

9′ Characters not as above 10

10 (9′) Metasternum with distinctive long and dense pubescence lateral to each plaque; pronotum smaller, more incised at rear; Pacific coast states 11

10′ Metasternum without unusual long and dense pubescence lateral to plaques, pronotum larger, less incised at rear 12

11 (10) Aedeagus as illustrated (Fig. 29C) . . . . *H. vandykei* d'Orchymont, p. 100

11′ Aedeagus as illustrated (Figs. 30A,B) . . . . *H. sierra*, new species, p. 101

12 (10′) Legs and lateral borders of pronotum ochraceus; aedeagus as illustrated (Fig. 28C) . . . . *H. californica*, new species , p. 88

12′ Legs and lateral borders of pronotum brown or black 13

13 (12′) Aedeagus with setae of parameres short, sparse 14

13′ Aedeagus with setae of parameres long, dense 15

14 (13) Aedeagus as illustrated (Figs. 26A,C,D) . . . . *H. pacifica*, new species, p. 86

14′ Aedeagus as illustrated (Fig. 28D) . . . . *H. petila*, new species, p. 91

15 (13′) Aedeagus with parameres broad in lateral view 16

15′ Aedeagus with parameres slender in lateral view 17

16 (15) Aedeagus as illustrated (Fig. 22A) . . . . *H. tuolumne*, new species, p. 79

16′ Aedeagus as illustrated (Fig. 22B) . . . . *H. occidentalis*, new species, p. 78

17 (15′) Aedeagus as illustrated (Fig. 22C) . . . . *H. arenicola*, new species p. 75

17′ Aedeagus as illustrated (Fig. 22D) . . . . *H. circulata*, new species, p. 74

Key to *leechi* Group species of Western Hemisphere *Hydraena*

1 (0) Pronotal scintilla present (Figs. 31C,32B,40D) 2

1′ Pronotal scintilla absent 30

2 (1) Male metatibial brush present (Figs. 32D-G) 3

2′ Male metatibial brush absent; female specimens 9

3 (2) Plaques oval or absent 4

3′ Plaques carinate 7

4 (3) Tubercle lateral to each plaque (Figs. 31H,35B); aedeagus as illustrated (Fig. 33D); southern Arizona . . . . *H. bituberculata*, new species, p. 109

4′ Tubercle absent 5

5 (4′) Size larger, about 1.92 - 2.02 mm long; protibia excavate near apex; profemoral prominence cariniform; aedeagus as illustrated (Figs. 36B,D); Oaxaca and Hidalgo, Mexico . . . . *H. scintilla*, new species, p. 111

5′ Size smaller, about 1.85 mm long or less; protibia not excavate near apex; profemoral prominence tuberculate 6

6 (5′) Size larger, about 1.80 x 0.76 mm; aedeagus as illustrated (Fig. 33A); Arizona,

New Mexico, Texas, northern Mexico .... *H. leechi*, new species, p. 103
6′ Size smaller, about 1.76 x 0.76 mm; aedeagus as illustrated (Fig. 36A); Jalisco, Mexico .... *H. scopula*, new species, p. 115
7 (3′) Plaques truncate posteriorly; aedeagus as illustrated (Fig. 36C); Zacatecas, Mexico .... *H. canticacollis*, new species, p. 113
7′ Plaques not truncate posteriorly 8
8 (7) Plaques arcuate; protibia parallel sided; aedeagus as illustrated (Fig. 33B); Durango, Mexico .... *H. breedlovei*, new species, p. 106
8′ Plaques straight; protibia expanded; aedeagus as illustrated (Fig. 33C); southern Arizona .... *H. arizonica*, new species, p. 108
9 (2′) Tubercle lateral to each plaque; southern Arizona; females of .... *H. bituberculata*, new species, p. 109
9′ Tubercle absent 10
10 (9′) Elytral punctures on disc random 11
10′ Elytral punctures on disc in series 12
11 (10) Form narrow, length about 2.92 times width; longer, about 1.46 mm; aedeagus as illustrated (Fig. 41C); Appalachian Mountains of Virginia .... *H. maureenae*, new species, p. 138
11′ Form wider, length about 2.02 - 2.30 times width; shorter, about 1.38 mm; aedeagus as illustrated (Figs. 41A,B); Ozark Plateau of Missouri, Oklahoma, Tennessee, Indiana .... *H. ozarkensis*, new species, p. 136
12 (10′) Procoxae separated from median carina by narrow shelf; Paraguay .... *H. paraguayensis* Janssens, p. 128
12′ Procoxae not separated from median carina by narrow shelf 13
13 (12′) Elytron with alternate intervals elevated; aedeagus as illustrated (Fig. 37A); Durango, Mexico .... *H. alternata*, new species, p. 116
13′ Elytron with alternate intervals not elevated 14
14 (13′) Elytral margin, viewed posteriorly, not elevated obliquely toward suture, not in form of angle with opposite elytron; Guatemala .... *H. puncticollis* Sharp, p. 130
14′ Elytral margin, viewed posteriorly, elevated obliquely toward suture, in form of angle with opposite elytron (Fig. 54E) 15
15 (14′) Profemur with carina on inner surface near base 16
15′ Profemur without carina on inner surface near base 18
16 (15) Pronotum shiny, finely sparsely punctate, punctures separated by two to three times puncture diameter; plaques absent; aedeagus as illustrated (Fig. 38B); Colombia .... *H. scintillabella*, new species, p. 118
16′ Pronotum dull, coarsely densely punctate, punctures separated by less than puncture diameter; plaques present 17
17 (16′) Pronotum unicolorous dark brown, lateral depressed areas microreticulate; aedeagus as illustrated (Fig. 39A); Peru .... *H. pavicula*, new species, p. 123
17′ Pronotum with dark brown, rectangular macula on disc, remainder testaceous, lateral depressed areas not microreticulate; aedeagus as illustrated (Fig. 38A); highlands of southeastern Brazil .... *H. scintillutea*, new species, p. 119
18 (15′) Plaques various shapes other than small ovals at posterior 0.20 of metasternum 19
18′ Plaques absent or reduced to small ovals at posterior 0.20 of metasternum ... 23

19 (18) Plaques arcuate 20

19′ Plaqes straight 21

20 (19) Plaques separated posteriorly by four times plaque width; aedeagus as illustrated (Fig. 39D); Colombia . . . . *H. colombiana*, new species, p. 127

20′ Plaques separated posteriorly by twice plaque width; Brazil . . . . *H. plaumanni* d'Orchymont, p. 129

21 (19′) Plaques subtriangular, each plaque tapered from posterior to anterior 22

21′ Plaques oval or subrectangular; aedeagus as illustrated (Fig. 37B); Chiapas, Mexico . . . . *H. campbelli*, new species, p. 132

22 (21) Pronotal punctures on disc separated by less than puncture diameter; aedeagus as illustrated (Fig. 39B); Argentina . . . . *H. costiniceps*, new species, p. 124

22′ Pronotal punctures on disc separated by one to two times puncture diameter; Bolivia . . . . *H. germaini* d'Orchymont, p. 126

23 (18′) Plaques absent 24

23′ Plaques reduced to small ovals at posterior 0.20 of metasternum 25

24 (23) Pronotal and elytral pubescence apparent; Durango, Mexico; females of . . . . *H. breedlovei*, new species, p. 106

24′ Pronotal and elytral pubescence obsolete; aedeagus as illustrated (Fig. 38C); highlands of southeastern Brazil . . . . *H. alterra*, new species, p. 121

25 (23′) Head with occipital area slightly emarginate in midline to receive scintilla . . . 27

25′ Head lacking emargination in midline of occipital area to receive scintilla; Arizona; females of . . . . *H. arizonica*, new species, p. 108

26 (25) Protibia stout, enlarged in apical 0.66; Oaxaca and Hidalgo, Mexico; females of . . . . *H. scintilla*, new species, p. 111

26′ Protibia not stout, gradually enlarged from base to apex 27

27 (26′) Pronotal punctation finer, sparser; Guatemala . . . . *H. sordida* Sharp, p. 129

27′ Pronotal punctation coarser, denser, ... 28

28 (27) Size smaller, 1.36 mm or less; aedeagus as illustrated (Fig. 38D); highlands of southeastern Brazil . . . . *H. terralta*, new species p. 122

28′ Size larger, 1.68 mm or more; Arizona, Mexico 29

29 (28′) Pronotal lateral margins more arcuate; size larger, about 1.88 mm; Arizona, New Mexico, Texas, northern Mexico; females of . . . *H. leechi*, new species p. 103

29′ Pronotal lateral margins less arcuate; size smaller, about 1.68 mm; Jalisco, Mexico; females of . . . . *H. scopula*, new species, p. 115

30 (1′) Elytral punctures on disc random 31

30′ Elytral punctures on disc serial 32

31 (30) Pronotal disc shiny, punctures separated by two to four times puncture diameter; interstices smooth; aedeagus as illustrated (Fig. 39C); Mexico . . . . *H. zapatina*, new species, p. 131

31′ Pronotal disc dull; interstices rough; aedeagus as illustrated (Fig. 45B); primarily coastal, Maryland to Florida . . . . *H. youngi*, new species, p. 150

32 (30′) Pronotal reliefs dull, microreticulate; aedeagus as illustrated (Fig. 44A); Chiapas, Mexico and Guatemala . . . . *H. oblio*, new species, p. 149

32′ Pronotal reliefs shiny, non-microreticulate or extremely faintly so 33

33 (32′) Metasternum with an anterior, median ridge (Fig. 48D) 34

33′ Metasternum lacking an anterior, median ridge 42

34 (33) Pronotum with anterior angles produced (Fig. 48C); broad, flat body: aedeagus as illustrated (Fig. 45A); Mexico, Nayarit to Oaxaca .... *H. cuspidicollis*, new species, p. 162

34′ Anterior angles of pronotum not produced 35

35 (34′) Mesosternal intercoxal process narrow, width about 0.25 distance between internal and median carinae; Durango, Mexico 36

35′ Mesosternal intercoxal process broad, width subequal to distance between internal and median carinae 37

36 (35) Pronotum with posterointernal foveolae more deeply impressed; elytra less rounded at sides; aedeagus as illustrated (Fig. 47D) .... *H. bractoides*, new species, p. 161

36′ Pronotum with posteroexternal foveolae less deeply impressed; elytra more rounded at sides; aedeagus as illustrated (Fig. 47C) .... *H. bractea*, new species, p. 160

37 (35′) Plaques separated by more than twice plaque width 38

37′ Plaques separated by less than twice plaque width 39

38 (37) Plaques elevated; depression between plaques well developed; pronotal discal punctures separated by two to three times puncture diameter; aedeagus as illustrated (Fig. 47A); Durango and Jalisco, Mexico .... *H. prieto*, new species, p. 157

38′ Plaques not elevated; depression between plaques slightly developed; pronotal discal punctures separated by puncture diameter; aedeagus as illustrated (Fig. 46A); Jalisco, Mexico .... *H. crystallina*, new species, p. 155

39 (37′) Plaques separated by plaque width or less; aedeagus as illustrated (Fig. 46C); Mexico, Mexico .... *H. scolops*, new species, p. 153

39′ Plaques separated by more than plaque width 40

40 (39′) Plaques elevated at lateral margins, relative to remainder of plaque; aedeagus as illustrated (Fig. 47B); Durango, Mexico ...... *H. argutipes*, new species, p. 158

40′ Plaques not elevated at lateral margins, relative to remainder of plaque 41

41 (40′) Metasternal ridge well developed, acute in cross-section; pronotal discal punctures separated by puncture diameter; size larger, about 1.70 x 0.72 mm; aedeagus as illustrated (Fig. 46D); Oaxaca, Mexico .... *H. oaxaca*, new species, p. 152

41′ Metasternal ridge weakly developed, rounded in cross-section; pronotal discal punctures separated by twice puncture diameter; size smaller, about 1.36 x 0.60 mm; aedeagus as illustrated (Fig. 46B); Jalisco, Mexico .... *H. mazamitla*, new species, p. 156

42 (33′) Plaques reduced to small ovals at posterior 0.17 of metasternum; aedeagus as illustrated (Fig. 41D); Tamaulipas, Mexico ..... *H. exilipes*, new species, p. 133

42′ Plaques various, not reduced to small ovals at posterior 0.17 of metasternum . 43

43 (42′) Plaques convergent anteriorly 44

43′ Plaques parallel 47

44 (43) Plaques separated at anterior by about four times greatest width of plaque; aedeagus as illustrated (Fig. 44B); northeastern United States .... *H. punctata* LeConte, p. 148

44′ Plaques separated at anterior by about twice greatest width of plaque 45

45 (44′) Elytral intervals about 0.25 puncture diameter in width; size larger, about 1.57 x 0.68 mm; Brazil .... *H. sahlbergi* d'Orchymont, p. 141

45′ Elytral intervals about puncture diameter in width; size smaller, about 1.30 x 0.58 mm 46

46 (45′) Elytral margins, viewed posteriorly, turned slightly upward toward suture; body form slightly broader; aedeagus as illustrated (Fig. 44C); primarily coastal, eastern United States, Maryland to Texas ..... *H. spangleri*, new species, p. 146

46′ Elytral margins, viewed posteriorly, not turned upward toward suture; body form slightly narrower; aedeagus as illustrated (Fig. 44D); Guadeloupe, Jamaica, Costa Rica .... *H. guadelupensis* d'Orchymont p. 145

47 (43′) Pronotal lateral margins not convergent from middle to anterior angles; posterointernal foveolae very slightly developed; aedeagus as illustrated (Fig. 64A); Venezuela, Guyana and Brazil ...... *H. hyalina*, new species, p. 179

47′ Pronotal lateral margins convergent from middle to anterior angles; posteroexternal foveolae generally more apparent 48

48 (47′) Pronotal posterointernal foveolae very lightly impressed or absent; form broad, about 1.18 x 0.52 mm; pronotum finely, moderately densely punctate; aedeagus as illustrated (Fig. 43C); Cuba .... *H. decui* Spangler, p. 144

48′ Pronotal posterointernal foveolae well developed; pronotum more coarsely and densely punctate 49

49 (48′) Size smaller, about 1.16 mm long; aedeagus as illustrated (Fig. 43D); Brazil .... *H. orcula*, new species, p. 140

49′ Size larger, about 1.40 mm long; aedeagus as illustrated (Figs. 43A,B); Honduras to Trinidad via mainland .... *H. particeps*, new species, p. 142

Key to *marginicollis* Group species of Western Hemisphere *Hydraena*

1 (0) Prosternal carina separated from procoxae by a narrow shelf; mesosternal intercoxal process broad, width slightly greater than distance separating internal and median carinae (Figs. 63A,F)(*geminya* Subgroup) 2

1′ Prosternal carina not separated from procoxae by a narrow shelf; mesosternal intercoxal process narrow, width less than distance separating internal and median carinae (Figs. 54B,I,63B) (*marginicollis* Subgroup) 4

2 (1) Pronotal fascia occupying median 0.33; plaques very narrow, separated posteriorly by eight times plaque width; aedeagus as illustrated (Fig. 64B); Nayarit, Mexico .... *H. vela*, new species, p. 206

2′ Pronotal fascia occupying median 0.50; plaques separated posteriorly by less than three times plaque width 3

3 (2′) Plaques less convergent anteriorly, nearly parallel, separated at anterior by more than plaque length; aedeagus as illustrated (Fig. 64C); Chiapas, Mexico .... *H. chiapa*, new species, p. 207

3′ Plaques more convergent anteriorly, separated at anterior by less than plaque length; aedeagus as illustrated (Fig. 64D); Oaxaca, Mexico .... *H. geminya*, new species, p. 209

4 (1′) Pronotum entirely testaceous or with testaceous borders and very faint light brown macula on disc 5

4′ Pronotal disc dark brown or black, usually with anterior and posterior margins light brown or testaceous 7

5 (4) Elytra with fine, close-set punctures in series; metasternum shallowly depressed between plaques; aedeagus as illustrated (Fig. 43C); Cuba . . . *H. decui* Spangler, p. 144

5′ Elytra with fine, sparse punctures which do not form definite rows; metasternum deeply impressed between plaques; Panama 6

6 (5′) Metasternal plaques located at border of inverted, V-shaped depression; elytra entirely brown; aedeagus as illustrated (Fig. 49C) . . . . *H. limpidicollis*, new species, p. 167

6′ Metasternal plaques located at border of inverted, U-shaped depression; elytra brown with faint ochraceous macula on disc; aedeagus as illustrated (Fig. 49D) . . . . *H. newtoni*, new species, p. 168

7 (4′) Elytra with at least some punctures on disc random, not forming discrete rows 8

7′ Elytra with discal punctures in rows 9

8 (7) Elytra of males greatly truncate, posterior margin of each elytron sinuate; plaques not carinae at lateral margins; aedeagus as illustrated (Fig. 52B); Trinidad, Guyana . . . . *H. premordica*, new species, p. 175

8′ Elytra not truncate, posterior margin of each elytron not sinuate; plaques carinate at lateral margins; aedeagus as illustrated (Fig. 58B); Colombia . . . . *H. anisonycha*, new species, p. 191

9 (7′) Plaques absent or reduced to small ovals at posterior 0.20 or metasternum . . . 10

9′ Plaques various, not reduced to small ovals at posterior 0.20 of metasternum . 17

10 (9) Plaques absent 11

10′ Plaques small ovals 12

11 (10) Elytral intervals and punctures equal in width; size smaller, about 1.48 x 0.60 mm; aedeagus as illustrated (Fig. 55A); eastern United States, primarily coastal, from New Jersey to Louisiana . . . . *H. marginicollis* Kiesenwetter, p. 184

11′ Elytral intervals 0.50 puncture width; size larger, about 1.56 x 0.56 mm; aedeagus as illustrated (Fig. 55C); eastern North America from Texas to southern Mexico . . . . *H. pulsatrix*, new species, p. 187

12 (10′) Size about 1.40 - 1.45 mm 13

12′ Size about 1.26 - 1.35 mm 15

13 (12) Aedeagus as illustrated (Fig. 49A); Argentina . . . . *H. tucumanica*, new species, p. 165

13′ Aedeagus not as above; Central America 14

14 (13′) Aedeagus as illustrated (Fig. 55D); southern Mexico and Guatemala . . . . *H. longicollis* Sharp, p. 190

14′ Aedeagus as illustrated (Fig. 55B); Costa Rica . . . . *H. turrialba*, new species, p. 186

15 (12′) Elytral intervals and punctures equal in width; aedeagus as illustrated (Fig. 51A); Guatemala . . . . *H. guatemala*, new species, p. 169

15′ Elytral intervals about 0.50 puncture diameter 16

16 (15′) Aedeagus as illustrated (Fig. 58A); Peru . . . . *H. peru*, new species, p. 190

16′ Aedeagus as illustrated (Fig. 60B); Costa Rica .... *H. nevermanni*, new species, p. 195
17 (9′) Plaques elevated at anterior or along entire length 18
17′ Plaques not elevated 20
18 (17) Plaques carinate along entire length; pronotal discal punctures separated by three to six times puncture diameter; very shiny species; aedeagus as illustrated (Fig. 52A); Mexico .... *H. grouvellei* d'Orchymont, p. 174
18′ Plaques elevated at anterior; pronotal discal punctures separated by one to three times puncture diameter 19
19 (18′) Metatibiae of males greatly expanded (Figs. 61A,B); metatibiae of females widest at midlength; aedeagus as illustrated (Fig. 62B); Chiapas, Mexico .... *H. d-destina*, new species, p. 200
19′ Metatibiae of both sexes gradually enlarging from base to apex; aedeagus as illustrated (Fig. 52D); Matto Grosso, Brazil .... *H. anaphora*, new species, p. 178
20 (17′) Metatibiae of males expanded; metatibiae of females widest at midlength; aedeagus as illustrated (Fig. 62C); Chiapas, Mexico .... *H. barricula*, new species, p. 202
20′ Metatibiae of both sexes gradually enlarged from base to apex 21
21 (20′) Plaques separated posteriorly by greatest width of a plaque; aedeagus as illustrated (Fig. 51B); Haiti .... *H. haitensis*, new species, p. 171
21′ Plaques separated posteriorly by more than greatest width of a plaque 22
22 (21′) Plaques triangular 23
22′ Plaques oval or elongate 24
23 (22) Size larger, about 1.54 x 0.68 mm; aedeagus as illustrated (Fig. 53D); Guadeloupe .... *H. insularis* d'Orchymont, p. 183
23′ Size smaller, about 1.48 x 0.64 mm; aedeagus as illustrated (Fig. 51D); Cuba .... *H. perkinsi* Spangler, p. 172
24 (22′) Aedeagus with parameres originating below midlength of main-piece 25
24′ Aedeagus with parameres originating above midlength of main-piece 30
25 (24) Aedeagus with left paramere as long as main-piece (Fig. 64A); Venezuela, Guyana and Brazil .... *H. hyalina*, new species, p. 179
25′ Aedeagus with left paramere shorter than main-piece 26
26 (25′) Aedeagus with left paramere originating at same distance from base as right paramere 27
26′ Aedeagus with left paramere originating above insertion of right paramere 28
27 (26) Aedeagus with right paramere extended to apex of main-piece (Fig. 49B); Ecuador .... *H. quechua*, new species, p. 166
27′ Aedeagus with right paramere not extending to apex of main-piece (Fig. 51C); Mexico .... *H. mexicana*, new species, p. 171
28 (26′) Aedeagus expanded in lateral view (Fig. 53C); Trinidad .... *H. trinidensis*, new species, p. 182
28′ Aedeagus not expanded in lateral view 29
29 (28′) Aedeagus with terminal-piece shorter than distance separating base of main-piece and insertion of right paramere (Fig. 52C); Ecuador .... *H. jivaro*, new species, p. 176

29′ Aedeagus with terminal-piece longer than distance separating base of main-piece and insertion of right paramere (Figs. 53A,B); Brazil and Venezuela . . . . *H. browni*, new species, p. 180
30 (24′) Aedeagus without a slender apical process (Fig. 62D); Chiapas, Mexico . . . . *H. splecoma*, new species, p. 204
30′ Aedeagus with a slender apical process 31
31 (30′) Aedeagus with left paramere longer than right 32
31′ Aedeagus with right paramere longer than left 33
32 (31) Size larger, about 1.60 x 0.68 mm; aedeagus as illustrated (Fig. 60A); Central America . . . . *H. colymba*, new species, p. 193
32′ Size smaller, about 1.30 x 0.52 mm; aedeagus as illustrated (Fig. 62A); southern Mexico and Guatemala . . . . *H. sabella*, new species, p. 199
33 (31′) Size larger, about 1.44 x 0.60 mm; aedeagus as illustrated (Fig. 60C); Costa Rica . . . . *H. malkini*, new species, p. 196
33′ Size smaller, about 1.14 x 0.48 mm; aedeagus as illustrated (Fig. 60D); Panama . . . . *H. pontequula*, new species, p. 198

The *circulata* Group

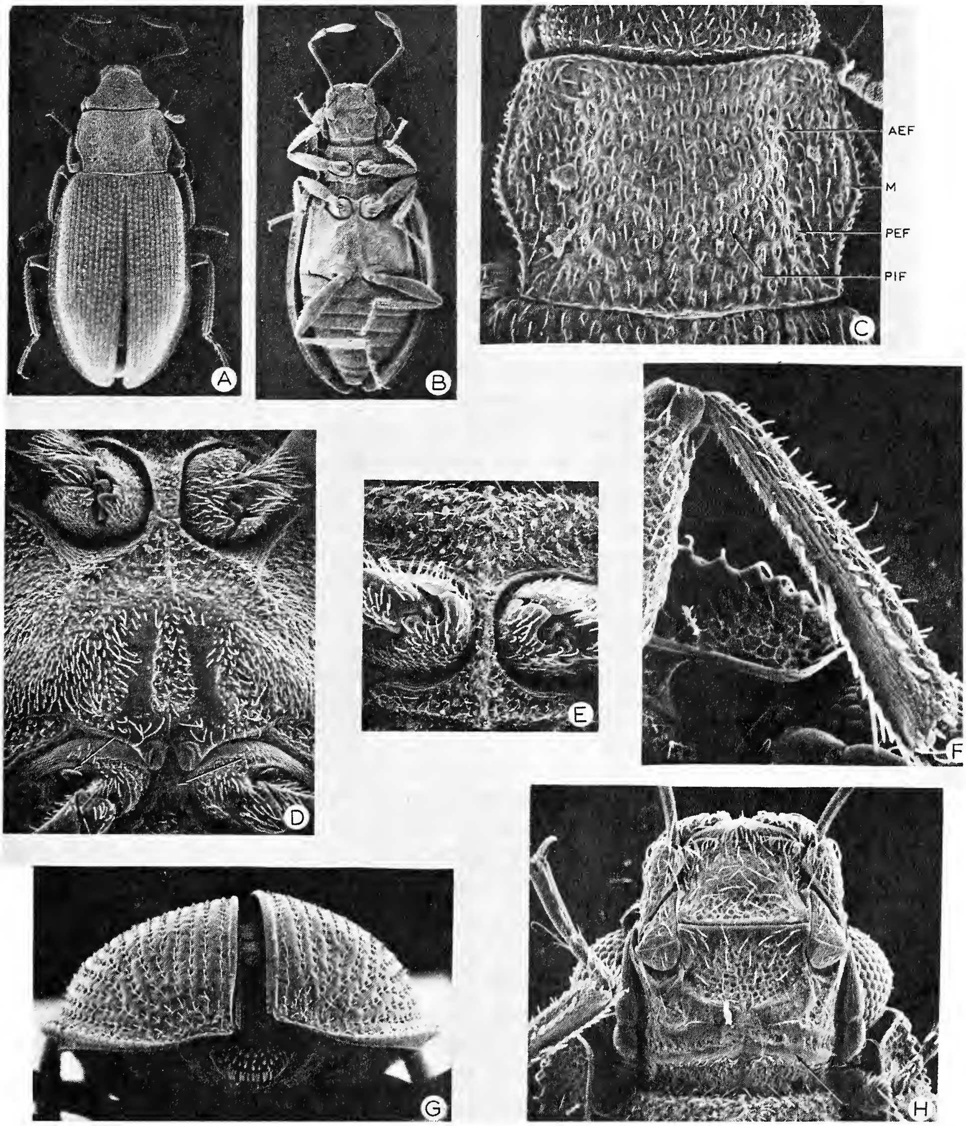
Members of the *circulata* Group are characterized by form of the ventral surface of the head, which has the posterior margin of the genae in the form of a transverse ridge (Fig. 21H). Additionally, adults have the intercoxal segment of the abdomen (Fig. 21D) concave, with the posterior margin arcuate. These characteristics are in contrast to those of the *leechi* and *marginicollis* Groups whose adults lack the genal ridge and have a flat intercoxal segment (cf. Figs. 48 D,E).

The aedeagus, which corroborates the proposed monophyly of *circulata* Group species, is very simple compared to that of males in the *leechi* and *marginicollis* Groups. The parameres originate at base of the median piece and are generally slender and with the apex enlarged very slightly, although they are flattened in males of a few species. The main-piece is tubular for most of its length, flattened at apex. Interspecific variation generally involves shape of the apex, in males of a few species also shape of the main-piece, and density and length of the setae on the parameres(cf. Figs. 22A, 24A, 28A).

Externally this group is quite uniform, requiring referral to the male genitalia for positive species assignment of adults. Those of most species have well developed plaques and relatively coarse, microreticulate pronotum and head. Adults of a number of species show a tendency toward subcarinate elytral intervals. Adults of only a single species, *H. quadricurvipes*, has modified legs, the legs of the other species being straight and lacking the various expansions, excavations, or processes seen in the *leechi* and *marginicollis* Groups.

Geographically, the *circulata* Group is entirely Nearctic, with the greatest concentration of species in the mountains of the Pacific coast states of the United States. A few species have a circular distribution pattern around the Great Basin, with the circular pattern interrupted by the barrier imposed by the arid regions of southeastern California and southwestern Arizona (see for example *Hydraena circulata*, Fig. 23A).

I have arranged the *circulata* Group in four complexes: *circulata*, *angulicollis*, *atlantica* and *pennsylvanica*. These complexes are based upon similarity of aedeagal structure, discussed



Figs. 21A – H, *Hydraena circulata*. (A) dorsal habitus. (B) ventral habitus. (C) pronotum (AEF = anteroexternal foveola, M = margin, PEF = posteroexternal foveola, PIF = posterointernal foveola). (D) metasternum (arrows indicate metacoxal sensillum and intercoxal sternite). (E) prosternum. (F) protibia. (G) elytra, posterior aspect. (H) head, ventral aspect (arrow indicates genal ridge).

in the phylogeny section.

The *circulata* Complex

1. *Hydraena circulata* new species
(Figs. 10I,21A-H,22D,E,23A,148C,164A)

Type-locality. – Little Chico creek at School road, E. of Forest Ranch, 2300 feet, Butte County, California.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in CAS. Hugh B. Leech collected these specimens September 1, 1961. Paratypes (790) are listed in the appendix.

Diagnosis. – Only males can be reliably assigned to *Hydraena circulata*, on the basis of genitalic features.

Description. – *Form*: Elongate. *Size*: Holotype 1.80 mm long, 0.72 mm wide. *Color*: Dorsal surface dark brown. Maxillary palpi brown; antennae testaceous. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum, brown. *Head*: Length 0.24 mm. Width 0.44 mm. Frons punctation coarse, punctures separated by 0.50 puncture diameter, or less; microreticulation both in punctures and on interstices; surface dull. Frontoclypeal suture arcuate to rear. Clypeus microreticulate except at anterior margin. Labroclypeal suture straight across middle when viewed from above. Labrum bilobed, microreticulate, each lobe asymmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2,3 and 4, respectively: 0.26/0.12/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral and medial surfaces arcuate, widest slightly past midlength. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulation similar to mentum. Genae moderately dull, finely microreticulate, lateral area of each gena with well developed foveola; posterior ridge well developed. Postgena microreticulation slightly smaller than that of submentum. Last five antennomeres pubescent. Eyes 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (at approximately midlength) 0.52 mm; sides margined, denticulate; sides moderately produced at middle, slightly sinuate and slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.44 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.48 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola closer together than those on disc. Antero- and posteroexternal foveolae confluent, sides of pronotum explanate. Transverse foveola moderately developed, punctures closer together than punctures on disc. Disc dull, punctation coarse, punctures deeply impressed, separated by 0.50 puncture diameter; microreticulation both in larger punctures and on interstices; most punctures with seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina not produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina not extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered, apex subacute, width near apex 0.33 distance between internal and median carinae. Metasternum with low ridge posterior to intercoxal process; plaques well developed, straight, convergent moderately from posterior to anterior; plaques 0.50 length of metasternum in midline; width of each plaque slightly less than width of intercoxal process at its mid-length; plaques separated posteriorly by approximately twice plaque width; plaques separated anteriorly by plaque width; plaques flat in cross section. *Elytra*: Length 1.20 mm. Maximum width (at midlength) 0.72 mm. Surface moderately shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures rectangular; intervals elevated, width approximately equal to 0.33 puncture width, also interstices between adjacent punctures of a row; each puncture with seta. Explanate margin moderately developed, ended near apices, with extremely fine, well separated serrations along entire margin; serrations larger near anterior angles. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated very slightly obliquely toward suture, in form of slight angle with opposite elytron. *Abdomen*: Intercoxal segment concave. Glabrous segments at apex only moderately produced. Sternum 7 very slightly emarginate at apex. *Legs*: Without apparent modification. *Genitalia*: Aedeagus as illustrated (Figs. 22D,E). (353 examined).

Variation. – Throughout most of its extensive range, adults of this species have the pronotal punctation coarse, the punctures separated by thin walls. In Arizona specimens, however, the pronotum is much smoother and more reflective, the punctures separated by about 0.50 the

diameter of a puncture. Many of these Arizona specimens are light brown, although some are dark brown or black. Specimens from parts of the range other than Arizona are generally dark brown or black. The parameres of specimens from Arizona and Colorado (Fig, 22E) are blunt at the apex and have the setae denser and distributed further down the paramere. From the external and genitalic details, apparently gene exchange rate between the Arizona and southern California populations (Fig. 23A) is very low, due to the barrier imposed by the southwestern deserts.

Natural History. – Most records cite "stream", "creek" or "river" as part of the locality description. More unusual habitat descriptors include "pool in drying up stream", "foul pool, dried bed of creek" "puddle in grassy slope", "ephemeral stream", "pond", "Ranunculus pool", "seepage trickle over gravelly soil", "seepage over rocks and small cliffs", "clear water pools in gravel and stones of otherwise dry and shaded creek", "ex seepage full of dead conifer leaves", "along lake shore", and "bog". Elsewhere (Perkins, 1976) I discussed the microhabitat preferences and associates of *Hydraena circulata* in southern California (*Hydraena circulata* and *H. vandykei* are discussed in that paper under the designation "*Hydraena* sp."). My research revealed that *Hydraena circulata* is primarily a psammolotic species. The descriptors cited above probably represent those microhabitats which are secondary, being used at times of overpopulation, or those microhabitats that the beetles are forced into as streams become dry.

Distribution. – (Figs. 23A,162A). *Hydraena circulata* is the most widespread and one of the most common western species of the *circulata* Group. Distribution forms a circular pattern, from southern California and northern Baja California northward to British Columbia, then southward in the Rocky Mountains to southern Arizona.

Etymology. – Latin, *circulata* (forming a circle). The name refers to the geographical distribution pattern.

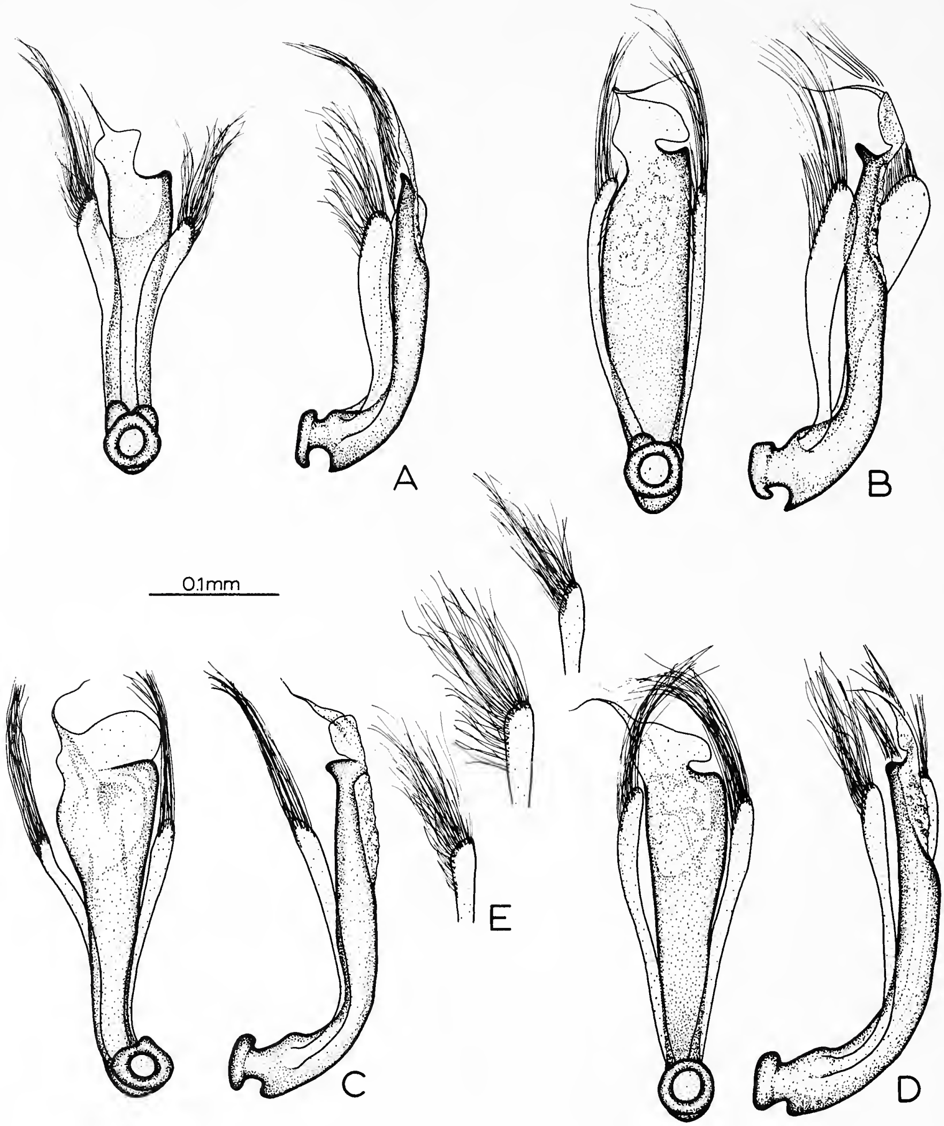
2. *Hydraena arenicola* new species
(Figs. 22C,27D,164A)

Type-locality. – 6.9 miles N. Middletown, on highway 29, Lake County, California.

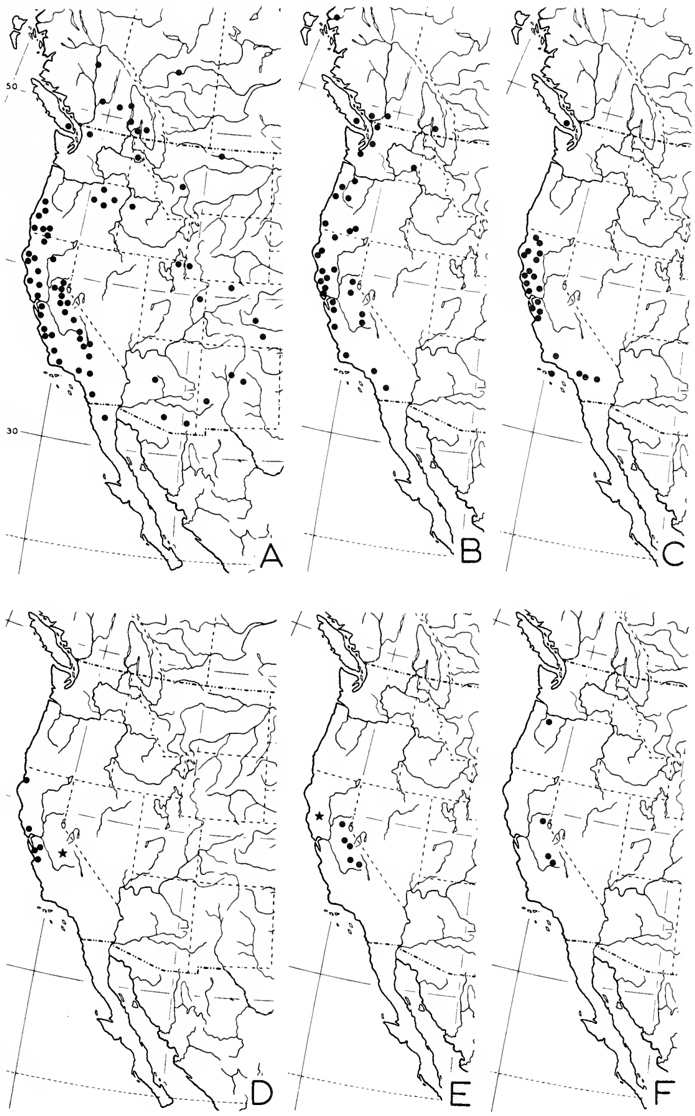
Type-specimens. – The holotype male and allotype with identical locality data are deposited in CAS. Hugh B. Leech collected these specimens February 20, 1955. Paratypes (433) are listed in the appendix.

Diagnosis. – The aedeagus must be studied to reliably recognize males of *H. arenicola.*

Description. – *Form*: Elongate. *Size*: Holotype 1.76 mm long, 0.72 mm wide. *Color:* Dorsal surface dark brown. Maxillary palpi and antennae brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum, brown. *Head:* Length 0.24 mm. Width 0.42 mm. Frons punctation coarse, punctures separated by 0.50 puncture diameter, or less; microreticulation present both in punctures and interstices; surface dull. Frontoclypeal suture arcuate to rear. Clypeus microreticulate except at anterior margin. Labroclypeal suture straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.26/0.10/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral and medial surfaces arcuate, widest near midlength. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulate. Genae moderately shining, punctulate; lateral area of each gena with well developed foveola; posterior ridge well developed. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (at approximately midlength) 0.52 mm; sides margined, denticulate; sides moderately produced at middle, slightly sinuate and slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.42 mm wide, straight and nearly perpendicular to midline in lateral 0.25 moderately arcuate to rear in middle 0.50; posterior border 0.44 mm wide, slightly arcuate to rear. Posterointernal foveolae well developed;



Figs. 22A – E, Aedeagi of *Hydraena* holotypes. (A) *H. tuolumne*. (B) *H. occidentalis*. (C) *H. arenicola*. (D) *H. circulata*. (E) parameres of *H. circulata* (from (top to bottom) Blaine County, Montana; Huerfano County, Colorado; and Cochise County, Arizona).



Figs. 23A – F, Geographical distributions of *Hydraena* species. (A) *H. circulata*. (B) *H. occidentalis*. (C) *H. vandykei*. (D) *H. californica* ● and *H. yosemitensis* ★. (E) *H. tuolumne* ● and *H. mignymixys* ★. (F) *H. sierra*.

punctures in foveola closer together than those on disc. Antero- and posteroexternal foveolae confluent, sides of pronotum explanate. Transverse foveola moderately developed, punctures closer together than punctures on disc. Disc dull, punctures separated by 0.50 puncture diameter, or less; microreticulation present in large punctures only, absent from interstices; most punctures with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina not produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina not extended to base of intercoxal process; intercoxal process relatively broad, sides tapering, apex subacute, width near apex 0.50 distance separating internal and median carinae. Metasternum with plaques well developed, straight, convergent moderately from posterior to anterior; plaques 0.50 length of metasternum in midline; width of each plaque 0.50 width of intercoxal process at its midlength; plaques separated posteriorly by slightly greater than plaque width; plaques separated anteriorly by slightly less than plaque width; plaques flat in cross section. *Elytra:* Length 1.12 mm Maximum width (at midlength) 0.72 mm. Surface dull, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures rectangular; intervals elevated, width approximately equal to 0.50 puncture width, as are interstices between adjacent punctures of a row; each puncture with seta. Explanate margin moderately developed, ended near apices, with serrations near anterior angles and apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment concave. Glabrous segments at apex weakly produced. Sternum 7 very slightly emarginate at apex. *Legs:* Without apparent modification. *Genitalia:* Aedeagus as illustrated (Fig. 22C) (195 examined).

Natural History. – The great majority of locality records cite "stream" or "creek" as the macrohabitat. More unusual notations include "pool in drying up stream", "foul pool dried bed of creek", "ephemeral stream", "moss-edged rock pools in running stream, open area", "clear water pools in gravel and stones of otherwise dry and shaded creek bed", and "small pool in drying Darlingtonia bog".

Distribution. – (Figs. 27D,164A). Northern Oregon south to southern California. Greatest population density in coastal mountain ranges of northern California.

Etymology. – Latin, *arena* (sand) plus *icola* (dweller). This name refers to the psammolotic habits of this species.

3. *Hydraena occidentalis* new species
(Figs. 22B, 23B, 164A)

Type-locality. – Bloody Run Creek, 7 miles E. of Route 101 on Longvale-Covelo road, 1100 feet, Mendocino County, California.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in CAS. These specimens were collected by Hugh B. Leech July 18, 1968. Paratypes (221) are listed in the appendix.

Diagnosis. – Aedeagi must be studied to identify males of this species.

Description. – *Form:* Elongate. *Size:* Holotype 2.04 mm long, 0.88 mm wide. *Color:* Dorsal surface dark brown except narrow border of pronotum and explanate margin of elytra testaceous. Maxillary palpi testaceous; antennae testaceous. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.28 mm Width 0.48 mm. Frons dull, punctation coarse, punctures separated by 0.50 puncture diameter, or less. Clypeus microreticulate. Labroclypeal suture straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended well above midlength of labrum. Maxillary palpus with following lengths(mm.) of palpomeres 2, 3 and 4, respectively: 0.32/0.12/0.26; second segment bending outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33 arcuate in apical 0.66 median surface arcuate; apical segment widest near apical 0.33, Mentum wider than long, surface moderately shining, finely microreticulate. Submentum microreticulate. Genae weakly shining; lateral area of each gena with well developed foveola; posterior ridge well developed. Postgena with microreticulation smaller than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (at approximately midlength) 0.62 mm; sides margined, denticulate; sides moderately produced at middle, sinuate and slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.52 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.5 2 mm wide, slightly arcuate to rear. Posterointernal foveolae slightly developed; punctures in foveola similar to those on disc. Antero- and posteroexternal foveolae confluent, in form of

explanate sides. Transverse foveola slightly developed, with punctures separated by thin walls. Disc dull, punctures relatively large and deeply impressed, separated by thin walls; most punctures finely microreticulate; most punctures with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina not produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad, sides tapered, apex rounded, width near apex 0.66 distance between internal and median carinae. Metasternum with carina in midline between anterior region of plaques and intercoxal process; plaques well developed, straight, convergent from posterior to anterior; plaques 0.57 length of metasternum in midline; width of each plaque 0.66 width of intercoxal process at its midlength; plaques separated posteriorly by approximately plaque width; plaques separated anteriorly by 0.50 plaque width; plaques flat in cross section; slightly elevated, oblique ridge lateral to each plaque. *Elytra:* Length 1.40 mm. Maximum width (at midlength) 0.88 mm. Surface dull, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures rectangular; intervals well elevated, width approximately 0.50 puncture width, as are interstices between adjacent punctures of a row; each puncture with seta. Explanate margin well developed, ended near apices, with serrations near anterior angles and in posterior 0.33. Elytral apices in dorsal aspect gradually rounded; posteriorly, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment concave. Glabrous segments at apex very weakly produced. Segment 7 without emargination at apex. *Legs:* Without apparent modification. *Genitalia:* Aedeagus as illustrated (Fig. 22B) (100 examined).

Natural History. – Stream or creek habitats are mentioned in most locality records. Unusual habitat notations include "ex moss in bed of dried-up woodland pool", "margin of Typha pool", and "ephemeral pond".

Distribution. – (Figs. 23B,164A). British Columbia, Washington, Oregon and California.

Etymology. – Latin, *occidentalis* (of the west). This name refers to the geographical distribution.

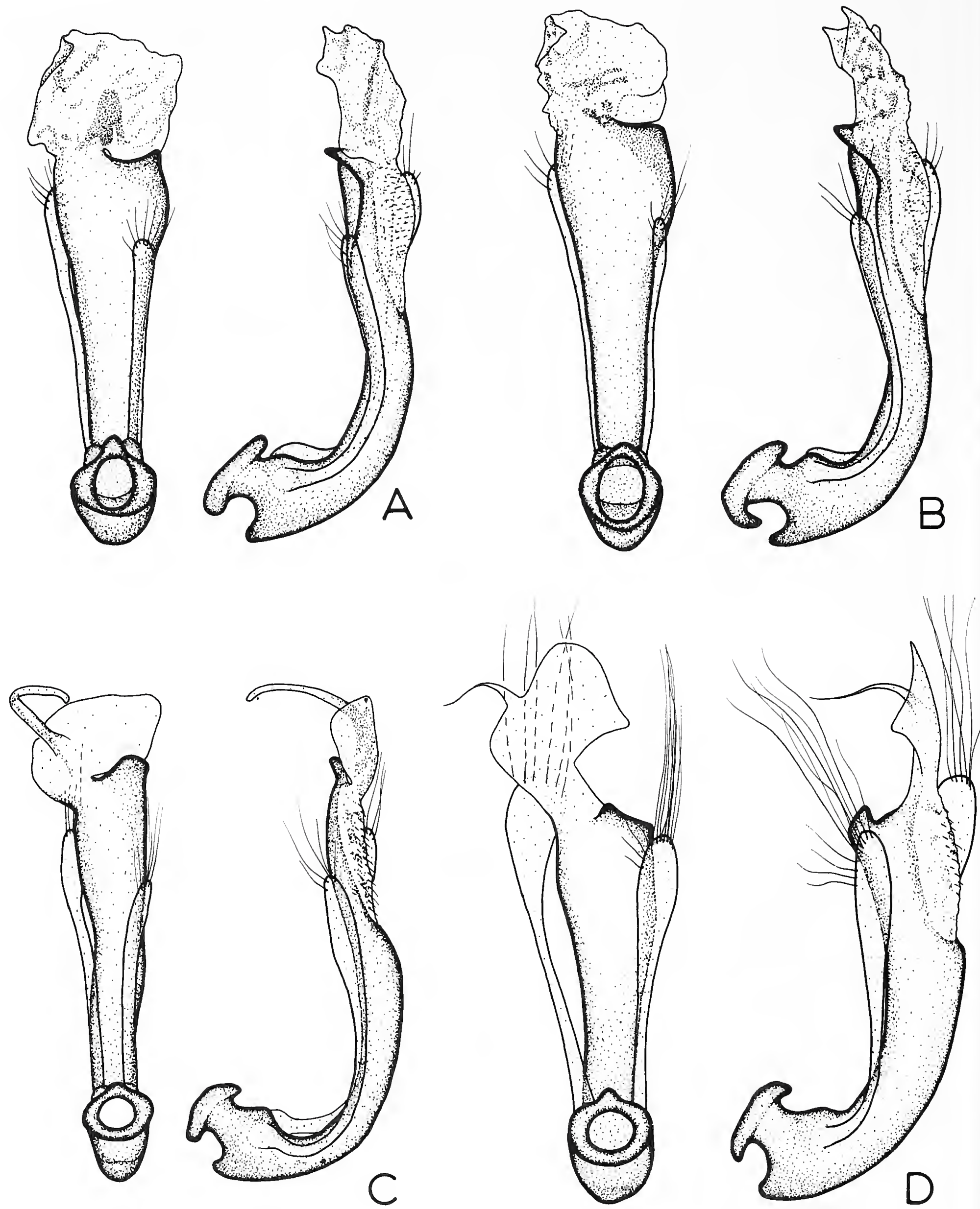
4. *Hydraena tuolumne* new species
(Figs. 22A, 23E, 164A)

Type-locality. – Tributary of Niagara Creek, Forest Campground, Tuolumne County, California.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in CAS. Hugh B. Leech collected these specimens September 21, 1963. Paratypes (46) are listed in the appendix.

Diagnosis. – Male genitalic characteristics are the only totally reliable diagnostic features.

Description. – *Form:* Elongate. *Size:* Holotype 1.88 mm long, 0.84 mm wide. *Color:* Head with dorsal surface and labrum dark brown; maxillary palpi testaceous except apices brown; antennae testaceous. Pronotum brown except dark brown macula on disc. Elytra brown. Ventral surface dark brown except legs, elytral epipleurae and inflexed margin of pronotum, brown. *Head:* Length 0.24 mm. Width 0.44 mm. Frons dull, punctation coarse, punctures separated by 0.33 puncture diameter, or less; microreticulation both in punctures and on interstices. Frontoclypeal suture straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe asymmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.32/0.12/0.24; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33 arcuate in apical 0.66 median surface evenly arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulation similar to mentum. Genae dull, finely microreticulate, lateral area of each gena with well developed foveola; posterior ridge well developed. Postgena with microreticulation slightly smaller than that of submentum. Last five antennomeres pubescent. Eyes 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (at approximately midlength) 0.58 mm; sides margined, denticulate; sides moderately produced at middle, slightly sinuate and slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.46 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.50 mm wide, slightly arcuate to rear. Posterointernal foveolae weakly developed; punctures in foveola similar to those on disc. Antero- and posteroexternal foveolae confluent. Transversal foveola moderately developed, many punctures in this area confluent. Disc dull, punctation coarse, punctures deeply impressed, many confluent; microreticulation quite evident in larger punctures, absent from interstices; most punctures with a distinctive seta which extends above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina not produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and



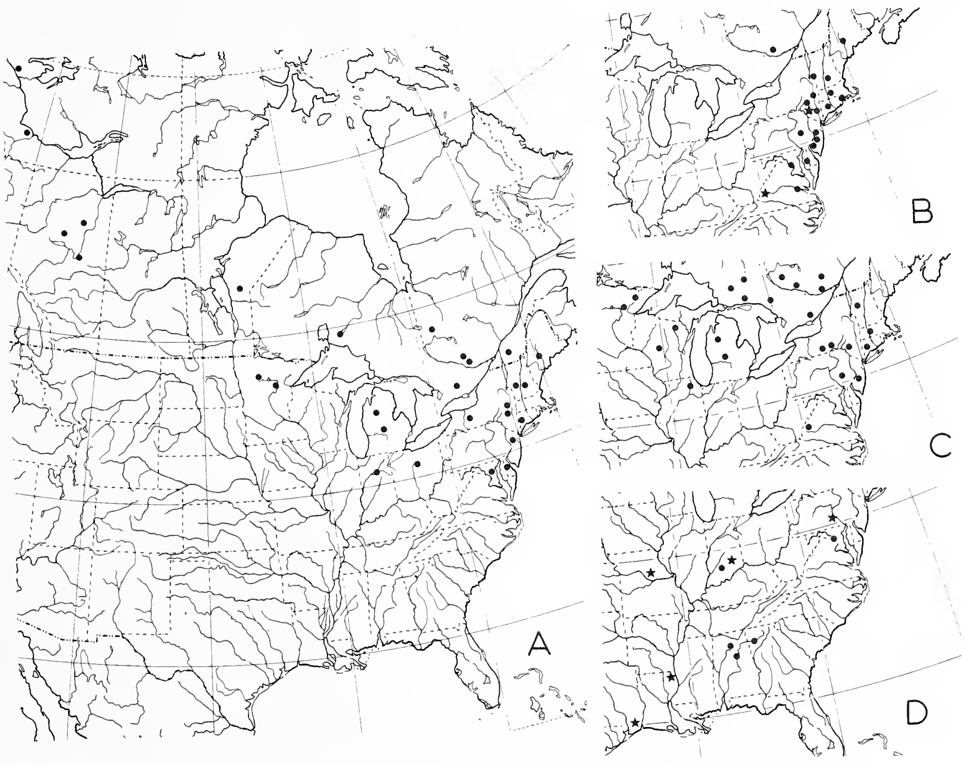
Figs. 24A – D, Aedeagi of *Hydraena* species. (A) *H. quadricurvipes*, holotype. (B) *H. quadricurvipes*, variant from Monroe County, Indiana. (C) *H. appalachicola*, holotype. (D) *H. angulicollis*, Hamilton County, New York.

external carinae divergent from anterior to posterior; median carina not extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered, width near apex 0.50 distance between internal and median carinae. Metasternum with plaques well developed, straight, covergent moderately from posterior to anterior; plaques 0.50 length of metasternum in midline; greatest width of each plaque subequal to width of intercoxal process at its midlength; plaques separated posteriorly by slightly less than plaque width; plaques separated anteriorly by 0.50 basal width of plaque; plaques flat in cross section; each plaque narrowed anteriorly. *Elytra:* Length 1.30 mm. Maximum width (at midlength) 0.84 mm. Surface dull, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures rectangular; intervals elevated, width approximately equal to 0.50 puncture width, as are interstices between adjacent punctures of a row; each puncture with a seta. Explanate margin moderately developed, ended near apices, with serrations near anterior angles and apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment concave. Glabrous segments at apex weakly produced. Segment 7 almost truncate at apex. *Legs:* Without apparent modification. *Genitalia:* Aedeagus as illustrated (Fig. 22A) (26 examined).

Natural History. – Most locality records mention flowing water habitats.

Distribution. – (Figs. 23E,164A). Restricted to the Sierra Nevada Mountains of California.

Etymology. – *tuolumne*, in reference to the type-locality.



Figs. 25A – D, Geographical distributions of *Hydraena* species. (A) *H. angulicollis*. (B) *H. atlantica* ● and *H. appalachicola* ★. (C) *H. pennsylvanica*. (D) *H. quadricurvipes* ● and *H. ancylis* ★.

The *angulicollis* Complex

5. *Hydraena angulicollis* Notman
(Figs. 24D,25A,164B)

Hydraena angulicollis Notman 1921:146 (holotype female in SII; type-locality: Westfield, Chautauqua County, New York).

Diagnosis. – Adults are generally darker, smaller and the pronotal punctures are more widely separated than in adults of *H. pennsylvanica* and *H. ancylis* the other species from eastern North America with which it can be confused. Additionally, *H. angulicollis* adults generally do not have the elytral intervals elevated, whereas adults of the aforementioned species do, more or less. Specimens with external characteristics approaching those of *H. pennsylvanica* and *H. ancylis* can be reliably discerned only by referral to the aedeagus.

Description. – *Form:* Elongate oval. *Size:* Holotype 1.80 mm long, 0.80 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum dark brown except for narrow testaceous border. Elytra dark brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum, brown. *Head:* Length 0.24 mm. Width 0.44 mm. Frons punctation coarse, interstices between punctures thin walls to 0.50 puncture diameter; microreticulation in punctures only, absent from interstices; interstices shining. Frontoclypeal suture arcuate. Clypeus microreticulate except at anterior margin. Labroclypeal suture straight across middle when viewed from above. Labrum bilobed, microreticulate; each lobe an asymmetrical arc; median emargination ending at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.30/0.10/0/20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral and medial surfaces arcuate, widest near midlength. Mentum wider than long, surface moderately shining, finely and closely punctulate except middle, impunctulate. Submentum evenly, finely punctulate, punctures contiguous. Genae dull, finely punctulate; lateral area of each gena with well developed foveola; posterior ridge well developed. Postgena with punctation smaller than that of submentum. Last five antennomeres pubescent. Eyes 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.42 mm; maximum width (at approximately midlength) 0.58 mm; sides margined, denticulate; sides relatively slightly produced at middle, slightly sinuate and slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.48 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.50 mm wide, slightly arcuate to rear. Posterointernal foveolae slightly developed; punctures in foveola closer together than those on disc, separated by thin walls. Antero- and posteroexternal foveolae confluent, in form of explanate sides. Transverse foveola not developed, punctures in this area closer together than punctures on disc, separated by thin walls. Disc moderately dull, interstices shining, punctures separated by thin walls to puncture diameter, microreticulation only in punctures, absent from interstices; most punctures with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina not produced anteriorly as very short spine; coxae separated by thin, median carina; carina imperceptible anterior to coxae; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae parallel; median carina not extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered; apex subacute, width near apex 0.50 distance between internal and median carinae. Metasternum with plaques well developed, straight, converging moderately from posterior to anterior; plaques 0.50 length of metasternum in midline; greatest width of each plaque subequal to width of intercoxal process at its midlength; each plaque tapered slightly from posterior to anterior; plaques separated posteriorly by approximately plaque width; plaques separated anteriorly by approximately plaque width; plaques flat in cross section. *Elytra:* Length 1.24 mm. Maximum width (at midlength) 0.80 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures hexagonal; intervals not elevated, width approximately equal to 0.50 puncture width, as are interstices between adjacent punctures of a row; each puncture with seta. Explanate margin moderately developed, ended near apices, with serrations near anterior angles and in posterior 0.33. Elytral apices in dorsal aspect gradually rounded; in posterior aspect elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment concave. Glabrous segments at apex not produced. Segment 7 not emarginate at apex. *Legs:* Legs without apparent modification. *Genitalia:* Aedeagus as illustrated (Fig. 24D) (98 examined).

Variation. – Density of the pronotal punctures varies considerably. Most specimens have the punctures more widely separated than that seen in *H. pennsylvanica* adults. As stated in the diagnosis, *H. angulicollis* adults are also generally darker and smaller than those of *H. pennsylvanica.* However, I have studied collections from various localities, especially from

Michigan, each of which I judged all of the specimens to be *H. pennsylvanica* on the basis of external characteristics. Upon dissection these series were found to be composite. The aedeagi of males of the two species are highly dissimilar and cannot be confused. I have examined 184 specimens (see appendix).

Natural History. – Locality descriptors include "leaf litter using a Berlese funnel", "sifting leaves", "sphagnum, streamside alder swamp", "in shore debris", and "small lake edge". I have collected *H. angulicollis* in Maine, at the margin of a small stream. The microhabitat at that locality consisted of sand and gravel which was bordered by sphagnum moss. Further study is necessary to definitely demonstrate an affinity for sphagnum moss, which would be an unusual habitat preference for a member of the *circulata* Group, and for the genus in general.

Distribution. – (Figs. 25A, 164B). *H. angulicollis* is the only *Hydraena* with a trans-Canadian distribution, ranging from Fort Simpson, Northwest Territories in Canada southeastward to Maryland.

Remarks. – Although the holotype is a female, it is the externally distinctive form (see variation), and I have no reservations concerning its identity.

6. *Hydraena appalachicola* new species
(Figs. 24C,25B,164B)

Type-locality. – Two miles S. Mountain Grove, Blowing Springs public camp, Bath County, Virginia.

Type-specimens. – The holotype male is deposited in USNM. My wife Maureen and I collected this specimen June 3, 1973. The allotype, which is also deposited in USNM is labelled: 12 miles S. Williamsville, Bath County, Virginia, M. E. and P. D. Perkins. One male paratype with same data as the holotype is in PDP. Two male and one female paratypes, also deposited in my collection, are labelled: 5 miles NE New Paltz, Ulster County, New York, P. D. Perkins.

Diagnosis. – These attractive specimens are easily distinguished from other members of the *circulata* Group by the non-serial arrangement of the punctures on the elytral disc. Only adults of *H. mignymixys*, a California species, also have some non-serial elytral punctures, but differ greatly in body form, color and sculpture. The following features make the pronotum of *H. appalachicola* adults very distinctive: (1) the disc has a rectangular, black or dark brown macula which is surrounded by, and contrasts with, the testaceous borders, (2) the punctures are rather coarse, but are apparently not microreticulate and are well separated by the very shiny interpunctal areas, and (3) the sides in the posterior are deeply incised.

Description. – *Form:* Elongate oval. *Size:* Holotype 1.56 mm long, 0.76 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum testaceous except for transverse, rectangular, dark brown macula on disc. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum, testaceous. *Head:* Length 0.22 mm. Width 0.42 mm. Frons punctation coarse, punctures separated by 0.50 puncture diameter; microreticulation on interstices and in punctures; surface moderately dull. Frontoclypeal suture arcuate to rear. Clypeus finely microreticulate. Labroclypeal suture straight across middle in dorsal aspect. Labrum bilobed, microreticulate; each lobe asymmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2,3 and 4, respectively: 0.24/0.08/0.18; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral and medial surfaces arcuate, widest near basal 0.33. Mentum wider than long, surface moderately shining, punctures fine, contiguous except in middle. Submentum evenly, finely punctulate, punctures contiguous. Genae moderately shining, finely punctulate; area of each gena with a well developed foveola; posterior ridge well developed. Postgena with punctation similar in size to that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (at approximately midlength) 0.56 mm; sides margined, denticulate; sides moderately produced at middle, slightly sinuate and slightly

convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.48 mm wide, straight and nearly perpendicular to midline in lateral 0.25 moderately arcuate to rear in middle 0.50 posterior border 0.44 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola closer together than those on disc. Posteroexternal foveola moderately developed. Interfoveolar depression moderately developed. Area between external foveolae moderately elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola moderately developed, punctures closer together than punctures on disc. Disc shining, punctures deeply impressed, separated by thin walls to 0.50 puncture diameter; some punctures with seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina not produced anteriorly as very short spine; coxae separated by thin, median carina; carina a sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina not extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered apex subacute, width near apex 0.50 distance between internal and median carinae. Metasternum with plaques well developed, slightly arcuate; plaques 0.50 length of metasternum in midline; width of each plaque subequal to width of intercoxal process at its midlength; plaques separated by approximately twice plaque width; plaques flat in cross section. *Elytra:* Length 1.08 mm. Maximum width (at midlength) 0.76 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, however, rows somewhat irregular with serial arrangement of punctures ceasing in places; punctures large, intervals reduced to thin, irregular walls, interstices between adjacent punctures of a row much larger, frequently equal puncture diameter; most punctures with seta. Explanate margin moderately developed, ended near apices, with fine serrations in anterior and posterior 0.33. Elytral apices, in dorsal aspect gradually rounded; in posterior aspect elytral margin not elevated obliquely towards suture, not in form of angle with opposite elytron. *Abdomen:* Intercoxal segment concave. Glabrous segments at apex weakly produced. Segment 7 without emargination at apex. *Legs:* Without apparent modification. *Genitalia:* Aedeagus as illustrated (Fig. 24C)(4 examined).

Variation. – No significant variation was noted in the six specimens studied.

Natural History. – The specimens collected at the type-locality were in a sandy area of a stream outwash in the mountains of Virginia (Fig. 189A). The specimen from Bath County, 12 miles S. Williamsville, was collected at the margin of a small stream, the substratum of which consisted primarily of small, smooth slate fragments; this specimen was found in association with a large population of *Limnebius*, primarily *L. ozapalachicus*, but also including *L. discolor* Casey and *L. richmondi*, new species (Fig. 193B). The three specimens from Ulster County, New York, were in a small sandy area at the margin of a very rapid, very cold brook during winter.

Distribution. – (Figs. 25B,164B). Presently known from the Appalachian Mountains in the states of Virginia and New York.

Etymology. – *appalachian* plus *icola* (dweller). Named in reference to the geographical distribution.

7. *Hydraena nigra* Hatch, new status
(Figs. 27F,29D,164B)

Hydraena vandykei niger Hatch, 1965:20 (holotype male in UWA; type-locality: Galena, Blaine County, Idaho).

Diagnosis. – The carinate metasternal plaques serve as diagnostic features for these black, relatively smooth members of the *circulata* Group. Refer to the section on variation for further comments.

Description. – *Form:* Elongate oval. *Size:* Holotype 2.00 mm long, 0.76 mm wide. *Color:* Dorsal surface black. Maxillary palpi testaceous; antennae testaceous. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum, brown. *Head:* Length 0.24 mm. Width 0.42 mm. Frons punctation moderately coarse, punctures separated by 0.50 puncture diameter, or greater; microreticulation only in punctures, absent from interstices; interstices shining. Frontoclypeal suture arcuate to rear. Clypeus microreticulate except at anterior margin. Labroclypeal suture straight across middle when viewed from above. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively; 0.28/0.10/0.22; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral and medial surfaces slightly arcuate, widest past midlength. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulation similar to mentum. Genae dull, microreticulate, lateral area of each gena with a well developed foveola; posterior ridge well

developed. Postgena with microreticulation slightly smaller than that of submentum. Last five antennomeres pubescent. Eyes 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (at approximately midlength) 0.56 mm; sides margined, denticulate; sides moderately produced at middle, straight and slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.46 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate in rear in middle 0.50; posterior border 0.46 mm wide, slightly arcuate to rear. Posterointernal foveolae well developed; punctures in foveola closer together than those on disc. Posteroexternal foveola moderately developed. Interfoveolar depression moderately developed. Area between external foveolae moderately elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola weakly developed, with punctures separated by thin walls. Disc moderately shining, punctures microreticulate, generally separated by 0.50 puncture diameter although few in middle confluent; most punctures with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina not produced anteriorly into very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad, sides tapered, apex round, width near apex 0.66 distance between internal and median carinae. Metasternum with plaques well developed, straight, carinate at posterior, convergent moderately from posterior to anterior; plaques 0.50 length of metasternum in midline; greatest width of each plaque 0.25 width of intercoxal process at its midlength; plaques separated posteriorly by approximately six times plaque width; plaques separated anteriorly by twice plaque width. *Elytra:* Length 1.24 mm. Maximum width (at midlength) 0.76 mm. Surface moderately shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures irregularly shaped; intervals not elevated, surface quite irregular, reflections interrupted, width approximately equal to 0.50 puncture diameter, as are interstices between adjacent punctures of row; each puncture with seta. Explanate margin moderately developed, ended near apices, with extremely fine, well separated serrations along entire margin, those near anterior and posterior larger. Elytral apices, in dorsal aspect, gradually rounded; viewed posteriorly, elytral margin elevates slightly, obliquely toward suture, in form of slight angle with opposite elytron. *Abdomen:* Intercoxal segment concave. Glabrous segments at apex slightly produced. Segment 7 without emargination at apex. *Legs:* Without apparent modification. *Genitalia:* Aedeagus as illustrated (Fig. 29D)(50 examined).

Variation. – Of the 116 specimens studied, only 13 from a single locality in Tuolumne County, California did not have the metasternal plaques carinate. The plaques of these 13 specimens were, however, narrow and widely separated as is seen in the carinate forms. The aedeagi from this locality did not differ significantly from those of the remaining specimens studied.

Natural History. – Most locality descriptors mention “creek”, “stream” or “headwaters”, although there is one citation each of “bog” and “in moss”. This suggests that this species is primarily a lotic, psammophilous form. The fact that it has been collected at high elevations, as much as 9500 feet in Colorado, plus its absence from the coastal ranges of California, Oregon and Washington causes me to suspect that perhaps *H. nigra* is a cold adapted species.

Distribution. – (Figs. 27F,164B). Found in the Sierra Nevada Mountains of California south to the San Gabriel Mountains and north to southern Oregon, and in the Rocky Mountains from southern British Columbia south to New Mexico.

The *atlantica* Complex

8. *Hydraena atlantica* new species
(Figs. 25B,26B,150D,153A-C,165A)

Type-locality. – Plummers Island, Montgomery County, Maryland.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. Paul J. Spangler collected these specimens May 19, 1972. Paratypes (199) are listed in the appendix.

Diagnosis. – Adults are readily distinguished from those of other members of the *circulata* Group found in eastern North America by the dark brown pronotal macula which does not extend into the lateral explanate areas. The aedeagus (Fig. 26B) must be studied to identify teneral specimens.

Description. – *Form:* Elongate oval *Size:* Holotype 1.86 mm long, 0.80 mm wide. *Color:* Head with dorsal surface very dark brown; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum with dark brown macula on disc, not extended into lateral explanate areas; remainder of pronotum testaceous-orange. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.24 mm. Width 0.44 mm. Frons punctation coarse, microreticulate, interstices between punctures 0.50 puncture diameter; interstices shining. Frontoclypeal suture weakly arcuate to rear. Clypeus microreticulate. Labroclypeal suture straight when viewed from above. Labrum bilobed, microreticulate, each lobe asymmetrical arc; median emargination ending above midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.32/0.12/0.24; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral and medial surfaces slightly arcuate, widest near midlength. Mentum wider than long, surface moderately shining, finely punctulate. Submentum finely punctulate. Genae moderately shining with transverse impressions, lateral area of each gena with well developed foveola, posterior ridge well developed. Postgena with punctation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (at approximately midlength) 0.58 mm; sides margined, denticulate; sides moderately produced at middle, slightly sinuate and very slightly convergent to anterior angle, markedly sinuate and markedly convergent to posterior; anterior border 0.50 mm wide, straight and nearly perpendicular to midline in lateral 0.12, moderately arcuate to rear in middle 0.50, posterior border 0.48 mm wide, rather markedly arcuate to rear. Posterointernal foveolae extremely slightly developed; punctures in foveola similar to those on disc. Antero- and posteroexternal foveolae confluent, sides explanate and disc elevated, parallel-sided. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc relatively dull, but with interstices shining, punctures large and deeply impressed, separated by narrow walls; most punctures with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina not produced anteriorly as very short spine; coxae separated by a thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina not extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered apex round, width near apex 0.33 distance between internal and median carinae. Metasternum with plaques well developed, straight, convergent moderately from posterior to anterior; plaques 0.50 length of metasternum in midline; width of each plaque subequal to width of intercoxal process at its midlength; plaques separated posteriorly by approximately plaque width; plaques separated anteriorly by slightly less than plaque width; plaques flat in cross section; shallow furrow lateral to each plaque. *Elytra:* Length 1.24 mm. Maximum width (at midlength) 0.80 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures longer than wide; intervals very slightly elevated, width approximately equal to 0.50 puncture diameter, as are interstices between adjacent punctures of row; each puncture with seta. Explanate margin moderately developed, ended near apices, with well developed serrations near anterior angles and extremely fine, well separated serrations along remainder of margin. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin not elevated obliquely toward suture, not in form of angle with opposite elytron. *Abdomen:* Intercoxal segment concave. Glabrous segments at apex very slightly produced. Segment 7 without emargination at apex. *Legs:* Without apparent modification. *Genitalia:* Aedeagus as illustrated (Fig. 26B)(106 examined).

Natural History. – Habitat descriptors include "woodland pond", "pothole", and "pasture pool", indicating that *H. atlantica* may be primarily a lentic adapted species. Most collections, however, do not indicate habitat and the few mentioned above may or may not represent those macrohabitats where *H. atlantica* reaches its greatest reproductive potential. A detailed study of the natural history of this species is necessary to firmly establish its preferred habitat and limiting environmental factors.

Distribution. – (Figs. 25B,165A). Eastern North America from Maine south to Virginia.

Etymology. – Latin, *atlantica*, in reference to geographical distribution and presumed relationship to *H. pacifica* as indicated by aedeagal form.

9. *Hydraena pacifica*, new species
(Figs.26A,C-D,27A-C,165A)

Type-locality. – Tributary to Vance Creek, Trinity Valley, British Columbia, Canada.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in CAS. Hugh B. Leech collected these specimens October 3, 1946. Paratypes (634) are listed in the appendix.

Diagnosis. – Aedeagal form is the only feature which can be consistently relied upon to discriminate males of this species.

Description. – *Form:* Elongate-oval. *Size:* Holotype 1.96 mm long, 0.84 mm wide. *Color:* Head with dorsal surface black; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum black except extremely narrow, testaceous border at anterior and posterior. Elytra very dark brown, virtually black. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum, brown. *Head:* Length 0.26 mm. Width 0.6 mm. Frons moderately coarsely punctate, surface moderately dull. Frontoclypeal suture arcuate to rear. Clypeus microreticulate at sides, shining in midline. Labroclypeal suture straight when viewed from above. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended above midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.32/0.12/0.22; palpomere 2 bent outward at approximately midlength; apex of palpomere 2 more expanded than norm; palpomere 4 with lateral surface slightly angulate, median surface evenly arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface shining, finely microreticulate. Submentum with punctation similar to mentum. Genae shining; lateral area of each gena with well developed foveola; posterior ridge well developed. Postgena with punctation much smaller than that of submentum. Last five antennomeres pubescent. Eyes 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (at approximately midlength) 0.62 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.48 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50 posterior border 0.52 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola closer together than those on disc. Posteroexternal foveola well developed. Interfoveolar depression well developed. Area between external foveolae moderately elevated. Anteroexternal foveolae well developed, each foveola slightly crescent shaped, occupying slightly less than 0.33 width of anterior region of pronotum. Transverse foveola moderately developed, punctures separated by thin walls. Disc shining, punctures moderate sized, deeply impressed, separated by thin walls near anterior and posterior borders, by puncture diameter in middle; most punctures with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum very weakly carinate, carina not produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae parallel; median carina not extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered, apex acute, width near apex 0.25 distance between internal and median carinae. Metasternum with plaques well developed, straight, convergent moderately from posterior to anterior; plaques 0.57 length of metasternum in midline; width of each plaque subequal to width of intercoxal process at its midlength; plaques separated posteriorly by approximately plaque width; plaques separated anteriorly by 0.50 plaque width; plaques flat in cross section. *Elytra:* Length 1.32 mm. Maximum width (at midlength) 0.84 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures rectangular; intervals elevated, width slightly less than 0.50 puncture diameter, interstices between adjacent punctures of row generally narrower; each puncture with seta. Explanate margin moderately developed, ended near posterior 0.10, with fine serrations near anterior angles and apices. Elytral apices in dorsal aspect gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment concave. Glabrous segments at apex very slightly produced. Segment 7 without emargination at apex. *Legs:* Without apparent modification. *Genitalia:* Aedeagus as illustrated (Figs. 26A, C-D)(393 examined).

Variation. – Color varies from brown to black. There is also some variation in density of pronotal punctation, but no distinct geographical trends were noted. I have studied the aedeagus of more than 390 males and have found that there are three rather distinct forms, which I refer to as aedeagal morphs "A", "B" and "C" (Figs. 26A, C-D). Aedeagal morph "A", which is the morph of the holotype, has a very wide distribution (Fig. 27A) ranging from Los Angeles County, California northward through the Pacific coast states to British Columbia, then southward in the Rocky Mountains to Colorado, with a few localities in Nevada connecting the California and Rocky Mountain components. Aedeagal morph "B" is known only from the Pacific coast states and British Columbia, apparently absent from the Rocky Mountains in the United States (Fig. 27B). Aedeagal morph "C" (Fig. 27C) has a very restricted distribution, being found only in the inland mountains of northern California. I have seen a total of 89 males of the "B" morph and 26 males of the "C" morph. The localities of these latter two morphs are entered in the appendix, separately from the "A" morph localities

(which are designated paratypes). I am not totally convinced that one and not two or possibly three species are truly represented here. However, the genitalia are quite similar and could very well represent three stages in a morphocline. I have therefore decided to treat them as forms of a single species and hope that pointing out these differences will stimulate additional research into this problem. A total of 848 specimens of this species were studied (see appendix).

Natural History. – The vast majority of locality descriptors include the terms "stream" or "creek", indicating that *H. pacifica* is primarily a lotic species. Unusual citations include "pools in drying streambed", "streambed by sifting", "ex waterlogged limb in stream", "bog", "pools, small stream in Darlingtonia bog", and "moss".

Distribution. – (Figs. 27A-C). Western North America.

Etymology. – Latin *pacifica*, in reference to geographical distribution.

10. *Hydraena californica* new species
(Figs. 23D, 28C, 165A)

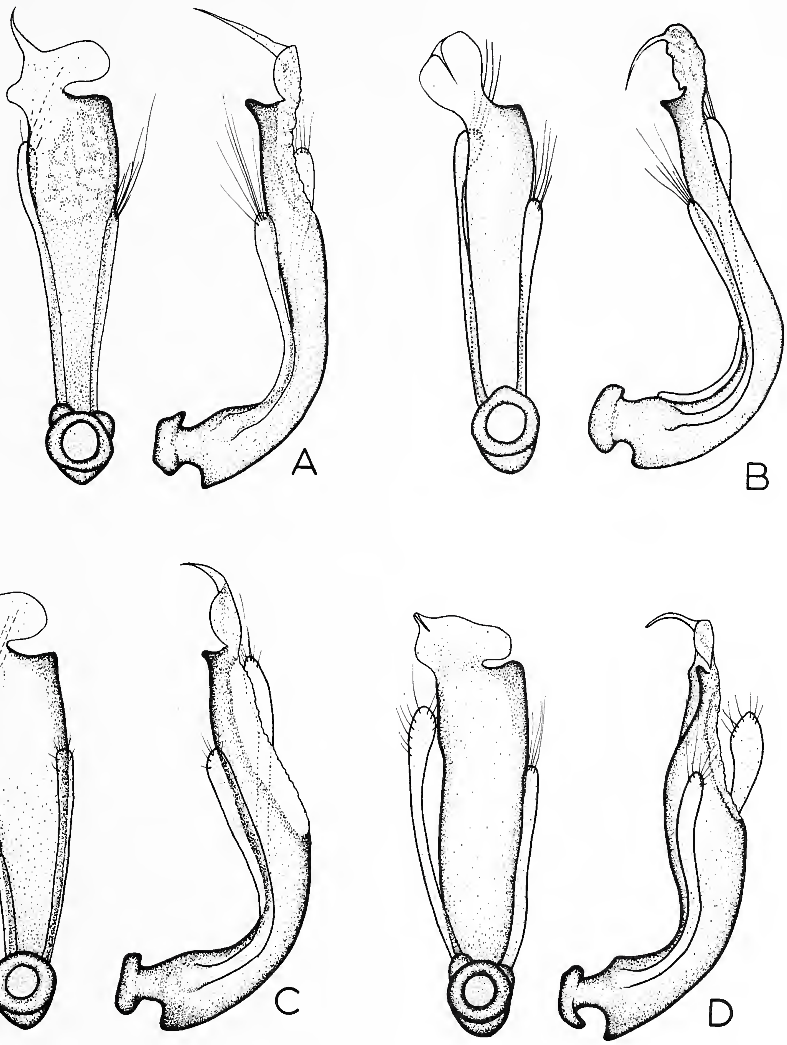
Type-locality. – Mill Valley, Marin County, California.

Type-specimens. – The holotype male is deposited in CAS. This specimen was collected by Hugh B. Leech, April 25, 1957. The allotype, which is also deposited in CAS, was collected at Redwood Park, Humboldt County, California by J. O. Martin in 1918. Paratypes (14) are listed in the appendix.

Diagnosis. – Aedeagal form plus ochraceous legs and lateral areas of the pronotum serve as diagnostic features for *H. californica* .

Description. – *Form:* Elongate-oval. *Size:* Holotype 1.76 mm long, 0.78 mm wide. *Color:*Head with dorsal surface brown; labrum brown; maxillary palpi testaceous; antennae testaceous. Pronotum with explanate sides ochraceous, remainder brown. Elytra brown except testaceous explanate margin. Ventral surface brown except legs, elytral epipleura and inflexed margin of pronotum, ochraceous. *Head:* Length 0.24 mm. Width 0.42 mm. Frons punctation lightly impressed, punctures separated by 0.50 puncture diameter; microreticulation both in punctures and on interstices, very lightly impressed on latter; surface dull. Frontoclypeal suture arcuate to rear. Clypeus microreticulate. Labroclypeal suture straight across middle when viewed from above. Labrum bilobed, microreticulate, each lobe asymmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.30/0.10/0.22;palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not expecially expanded; palpomere 4 with lateral surface weakly arcuate, median surface more markedly arcuate, palpomere 4 widest near midlength. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulate as mentum. Genae shining, microreticulate, lateral area of each gena with well developed foveola; posterior ridge well developed. Postgena microreticulate. Last five antennomeres pubescent. Eyes 0.17 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (at approximately midlength) 0.58 mm; sides margined, denticulate; sides moderately produced at middle, slightly sinuate and slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.46 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.48 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola closer together than those on disc. Antero- and posteroexternal foveolae confluent, sides of pronotum explanate. Area between external foveolae slightly elevated. Transverse foveola slightly developed, punctures separated by thin walls. Disc dull, punctures moderately small, separated by thin walls; most punctures without distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina not produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered, apex subacute, width near apex 0.33 distance between internal and median carinae. Metasternum with plaques well developed, straight, convergent moderately from posterior to anterior; plaques 0.50 length of metasternum in midline; width of each plaque subequal to width of intercoxal process at its midlength; plaques separated posteriorly by approximately twice plaque width; plaques separated anteriorly by plaque width; plaques flat in cross section. *Elytra:* Length 1.16 mm. Maximum width (at midlength) 0.78 mm. Surface moderately shining, disc with 10 rows of punctures between suture and humeral callus, rows and puncture shape quite irregular; intervals not elevated, reduced to narrow, irregular walls, as are interstices between adjacent punctures of row; each puncture with seta. Explanate margin well developed, ended near apices, with extremely fine, well separated serrations along entire margin. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect,

elytral margin elevated slightly obliquely toward suture, in form of slight angle with opposite elytron. *Abdomen:* Intercoxal segment concave. Glabrous segments at apex slightly produced. Segment 7 slightly emarginate at apex. *Legs:*Without apparent modification. *Genitalia:* Aedeagus as illustrated (Fig. 28C)(12 examined).

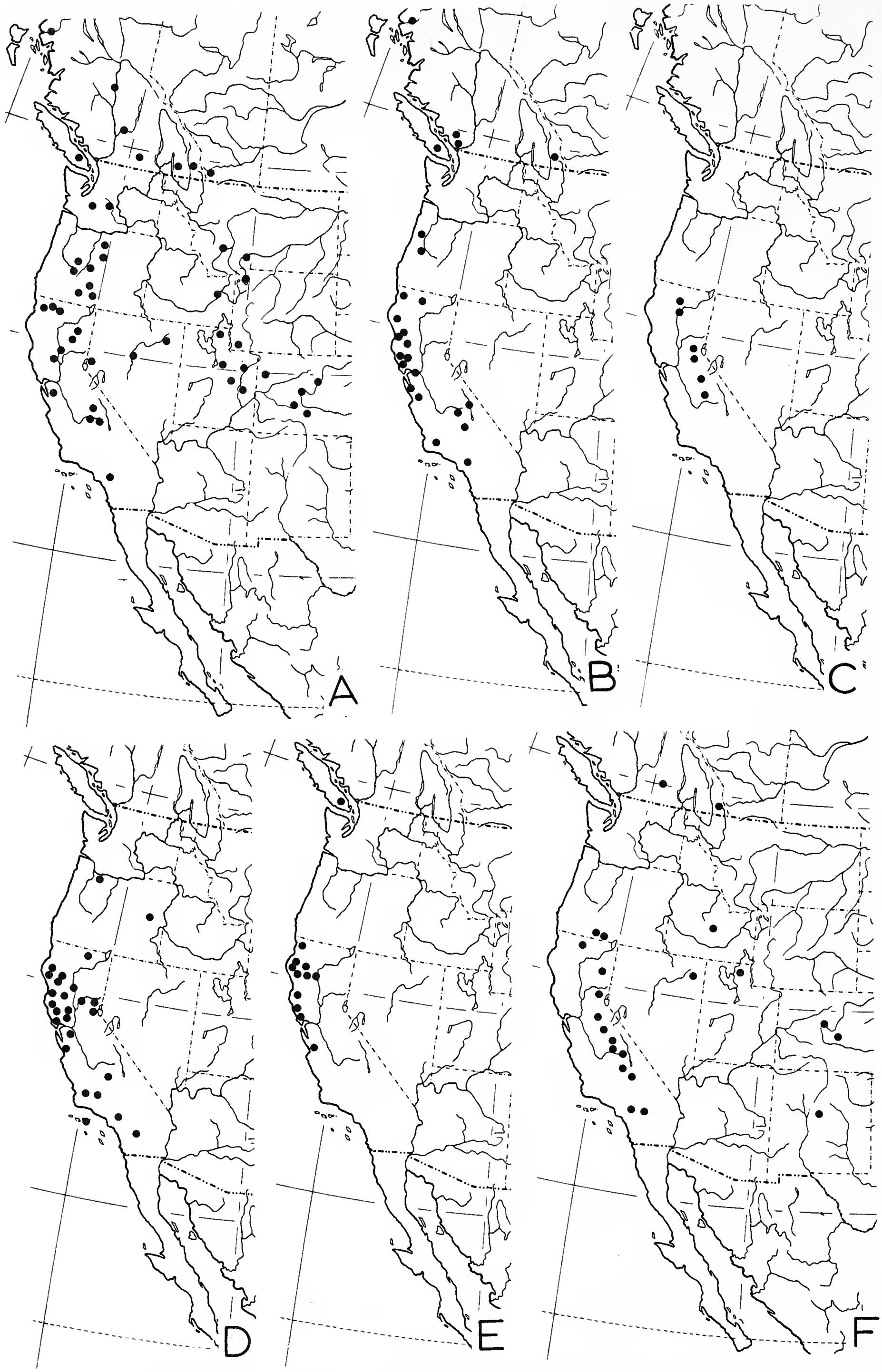


Figs. 26A – D, Aedeagi of *Hydraena* species. (A) *H. pacifica*, holotype. (B) *H. atlantica*, holotype. (C) *H. pacifica*, morph "B", Marin County, California. (D) *H. pacifica*, morph "C", Shasta County, California.

Natural History. – Two locality citations include the term "creek", the remaining citations give no information about habitat.

Distribution. – (Figs. 23D, 165A). Restricted to the coastal ranges of northern California from Humboldt County south to Santa Cruz County.

Etymology. – *H. californica*, in reference to the geographical distribution.



Figs. 27A – F, Geographical distributions of *Hydraena* species. (A) *H. pacifica*, morph "A". (B) *H. pacifica*, morph "B". (C) *H. pacifica*, morph "C". (D) *H. arenicola*. (E) *H. petila*. (F) *H. nigra*.

11. *Hydraena petila* new species
(Figs. 27E,28D,165A)

Type-locality. – Dead Mule spring, 3 km by road N. of Paskenta-Covelo road, 1570 meters, Tehama County, California.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in CAS. Hugh B. Leech collected these specimens August 29, 1972. Paratypes (96) are listed in the appendix.

Diagnosis. – Aedeagal form is the only totally reliable diagnostic feature for males of this species.

Description. – *Form:* Elongate-oval. *Size:* Holotype 1.90 mm long, 0.80 mm wide. *Color:* Dorsal surface black. Maxillary palpi testaceous; antennae testaceous. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum, brown. *Head:* Length 0.24 mm. Width 0.46 mm. Frons punctation coarse, punctures separated by 0.33 puncture diameter or less, microreticulation present both in punctures and on interstices; surface dull. Frontoclypeal suture arcuate to rear. Clypeus microreticulate except at anterior border. Labroclypeal suture straight across middle when viewed from above. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.32/0.12/0.22; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not expecially expanded; palpomere 4 with lateral and medial surfaces arcuate; widest slightly past midlength. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulation similar to mentum. Genae dull, microreticulate, lateral area of each gena with well developed foveola; posterior ridge well developed. Postgena with punctation slightly smaller than that of submentum. Last five antennomeres pubescent. Eyes 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (at approximately midlength) 0.60 mm; sides margined, denticulate; sides moderately produced at middle, slightly sinuate and slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.48 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.52 mm wide, slightly arcuate to rear. Posterointernal foveolae well developed; punctures in foveola closer together than those on disc. Anteroexternal and posteroexternal foveolae confluent; sides of pronotum explanate. Transverse foveola moderately developed, punctures separated by thin walls. Disc dull, punctures separated by 0.33 puncture diameter to thin walls; microreticulation in punctures, absent from interstices; each puncture with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina not produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina not extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered, apex subacute, width near apex 0.33 distance between internal and median carinae. Metasternum with low ridge posterior to intercoxal process; plaques well developed, straight, convergent moderately from posterior to anterior; plaques 0.57 length of metasternum in midline; width of each plaque 0.66 width of intercoxal process at its midlength; plaques separated posteriorly by approximately twice plaque width; plaques separated anteriorly by plaque width; plaques flat in cross section. *Elytra:* Length 1.28 mm. Maximum width (at midlength) 0.80 mm. Surface dull, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures rectangular; intervals elevated, width approximately equal to 0.50 puncture diameter, as are interstices between adjacent punctures of row; each puncture with seta. Explanate margin moderately developed, ended near apices, with serrations along entire margin, those near anterior angles and apices larger than remainder. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment concave. Glabrous segments at apex weakly produced. Segment 7 without emargination at apex. *Legs:* Without apparent modification. *Genitalia:* Aedeagus as illustrated (Fig. 28D)(52 examined).

Natural History. – Nearly all of the locality records indicate "creek" or "stream". Unusual habitat descriptions include "moss-edged rock pools in running stream, open area", and "clean water pools in gravel and stones of otherwise dry and shaded creek bed".

Distribution. – (Figs. 27E,165A). Coastal mountain ranges of central and northern California plus one locality at Vancouver, British Columbia.

Etymology. – Latin, *petila* (slender). This name refers to the slender aedeagus.

12. *Hydraena mignymixys* new species
(Figs. 23E,28B,165A)

Type-locality. – Dried bed of Cottage City creek, Lucerne, Lake County, California.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in CAS. Paratypes (11) from the same locality are deposited in CAS, USNM and PDP. Hugh B. Leech collected these specimens July 30, 1955.

Diagnosis. – Small, narrow body (1.56 x 0.60 mm) and non-serial arrangement of punctures on the elytral disc serve to distinguish adults of this species from other members of the *circulata* Group in western North America. *H. appalachicola* adults from eastern North America also have some non-serial elytral punctures on the disc but differ in body form, color and sculpture.

Description. – *Form:* Elongate. *Size:* Holotype 1.56 mm long, 0.60 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum testaceous except for dark brown macula on disc. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum, brown. *Head:* Length 0.20 mm. Width 0.38 mm. Frons punctation coarse, punctures confluent; microreticulation prominent within punctures; surface dull. Frontoclypeal suture slightly arcuate to rear. Clypeus microreticulate except at anterior border, very smooth. Labroclypeal suture straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively:0.26/0.10/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, arcuate in apical 0.66, median surface arcuate; palpomere 4 widest near midlength. Mentum wider than long, surface moderately shining, microreticulate. Submentum with punctation similar to mentum. Genae dull, microreticulate, lateral area of each gena with well developed foveola; posterior ridge well developed. Postgena with microreticulation smaller than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.17 interocular distance in width. *Thorax:* Pronotum length at midline 0.34 mm; maximum width (at approximately midlength) 0.44 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.38 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.38 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola confluent. Posteroexternal foveola weakly developed. Interfoveolar depression slightly developed. Area between external foveolae moderately elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola weakly developed. Disc dull, punctures confluent; interstices in form of irregular patterns; microreticulation quite evident within punctures, but absent from interstices; most large punctures with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina not produced anteriorly as very short spine; coxae separated by thin, median carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina not extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered, apex round, width near apex 0.33 distance between internal and median carinae. Metasternum with plaques well developed, straight, parallel; plaques 0.50 length of metasternum in midline; width of each plaque subequal to width of intercoxal process at its midlength; plaques separated by plaque width; plaques sloped slightly toward midline, each plaque very slightly concave. *Elytra:* Length 0.98 mm. Maximum width (at midlength) 0.60 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus at extreme anterior and in posterior 0.50, punctures in middle more deeply impressed and random; intervals in posterior 0.50 slightly elevated, width approximately equal to 0.33 puncture width, interstices between adjacent punctures of row generally narrower; each puncture with perceptible seta. Explanate margin quite narrow, ended near apices, with serration near anterior angles and in apical 0.25. Elytral apices, in dorsal aspect, gradually rounded; viewed posteriorly, elytral margin rises very slightly, obliquely towards suture, in form of very slight angle with opposite elytron. *Abdomen:* Intercoxal segment concave. Glabrous segments at apex weakly produced. Segment 7 without emargination at apex. *Legs:* Without apparent modification. *Genitalia:* Aedeagus as illustrated (Fig. 28B)(6 examined).

Distribution. – (Figs. 23E,165A). Known only from the type-locality at Lucerne, Lake County, California.

Etymology. – Greek, *mignymi* (mix up, mingle) plus *ixys* (the small of the back). This name refers to the non-serial arrangement of some punctures on the elytral disc.

13. *Hydraena quadricurvipes* new species
(Figs. 24A-B,25D,165A)

Type-locality. – 2 miles NE Subligna, outside Parker Cave, Chattooga County, Georgia.

Type-specimens. – The holotype male is deposited in CFMNH. This specimen was collected by S. Peck and A. Fiske June 20, 1967. The allotype, which is also deposited in CFMNH, has the following data; Alabama, St. Claire Co., 3 miles NE Whitney Junction, outside McGlendon Cave, June 15, 1967, S. Peck and A. Fiske collectors. Paratypes (7) are listed in the appendix.

Diagnosis. – Adults of this distinctive species are easily recognized by form of the meso- and metatibiae, which are very markedly arcuate in males and weakly arcuate in females. All other species in the *circulata* Group have straight meso- and metatibiae. Both sexes have the elytra broadly explanate and relative length of the ultimate segment of the maxillary palpus is greater than that seen in other species, more than twice the length of the penultimate article. *H. quadricurvipes* includes the most robust members of the *circulata* group.

Description. – *Form:* Moderately ovate, convex. *Size:* Holotype 1.90 mm long, 0.90 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum brown except dark brown macula on disc. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum, brown. *Head:* Length 0.26 mm. Width 0.46 mm. Frons punctation coarse, microreticulate; interstices between punctures 0.33 puncture diameter or less; microreticulation quite evident in larger punctures, present, but lightly impressed on interstices; surface dull. Frontoclypeal suture slightly arcuate to rear. Clypeus microreticulate. Labroclypeal suture straight across middle when viewed from above. Labrum bilobed, microreticulate; each lobe asymmetrical arc; median emargination ending slightly before midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.26/0.10/0.24; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface slightly arcuate; median surface sinuate; palpomere 4 widest slightly before midlength. Mentum wider than long, surface moderately dull, microreticulate. Submentum with microreticulation similar to mentum. Genae dull, with large, irregular punctures; lateral area of each gena with well developed foveola;posterior ridge well developed. Postgena with microreticulation similar to that of submentum. Last five antennomeres pubescent. Eyes 0.16 interocular distance in width. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (at approximately midlength) 0.64 mm;sides margined, denticulate; sides moderately produced at middle, slightly sinuate and very slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.54 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.54 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveolae well developed. Interfoveolar depression well developed, disc elevated. Area between external foveolae moderately elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc dull, punctures large and deeply impressed, separated by 0.33 puncture diameter or less; microreticulation well impressed in large punctures, very lightly impressed on interstices; most punctures without distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina not produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina not extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered, apex acute, width near apex 0.25 distance separating internal and median carinae. Metasternum with low ridge in midline between anterior region of plaques and intercoxal process; plaques well developed, medial margins convergent, lateral margins parallel, therefore each plaque wider at anterior than posterior; plaques 0.50 length of metasternum in midline; greatest width of each plaque 0.33 again larger than width of intercoxal process at its midlength; plaques separated posteriorly by approximately twice plaque width; plaques separated anteriorly by less than 0.50 plaque width; plaques flat in cross setion. *Elytra:* Length 1.28 mm. Maximum width (at midlength) 0.90 mm. Surface moderately dull, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures rectangular; intervals not elevated, width approximately equal to 0.50 puncture width, as are interstices between adjacent punctures of a row; most punctures without perceptible seta. Explanate margin quite broad, ended near apices, with serrations along entire margin, those near anterior angles well developed. Elytral apices, in dorsal aspect, gradually rounded; viewed posteriorly, elytral margin not elevated obliquely toward suture, not in form of angle with opposite elytron. *Abdomen:* Intercoxal segment concave. Glabrous segments at apex weakly produced. Segment 7 without apical emargination. *Legs:* Meso- and metatibiae markedly arcuate; apical 0.33 of each expanded. *Genitalia:* Aedeagus as illustrated (Figs. 24A-B)(4 examined).

Variation. – As noted in the diagnosis, the meso- and metatibiae of females are very slightly arcuate, whereas those of males are markedly so. Males from Indiana have the aedeagus

slightly different than that seen in the holotype and other southern specimens. I have illustrated the aedeagus of a specimen from Monroe County, Indiana for comparative purposes (Fig. 24B). No significant, non-sexual external variation was noted in the nine specimens studied.

Natural History. – The specimens from Alabama and Georgia were taken at or near the entrance to caves. The specimen from Marshall County, Alabama has the label notations, "River Cave" and "floor debris light zone at entrance". The holotype and one male paratype from Chattooga County, Georgia are from "outside Parker Cave" while the paratype from St. Claire County in the same state has the label reading, "outside McGlendon Cave". The latter three specimens were taken in berlese samples. One of the examples from Indiana was taken from a "small stream near Needmore", according to the label notation of F. N. Young. Label data of the remaining specimens do not describe habitat. Whether *H. quadricurvipes* truly has an affinity for cave entrance habitats, and whether the unusual legs of this species are causually related to that habitat are questions which require further study to clarify.

Distribution. – (Figs. 25D,165A). Presently known from the states of Indiana, Maryland, Alabama and Georgia.

Etymology. – Latin, *quadri* (four) plus *curv* (bend) plus *ipes* (foot). Named in reference to the arcuate meso- and metatibiae.

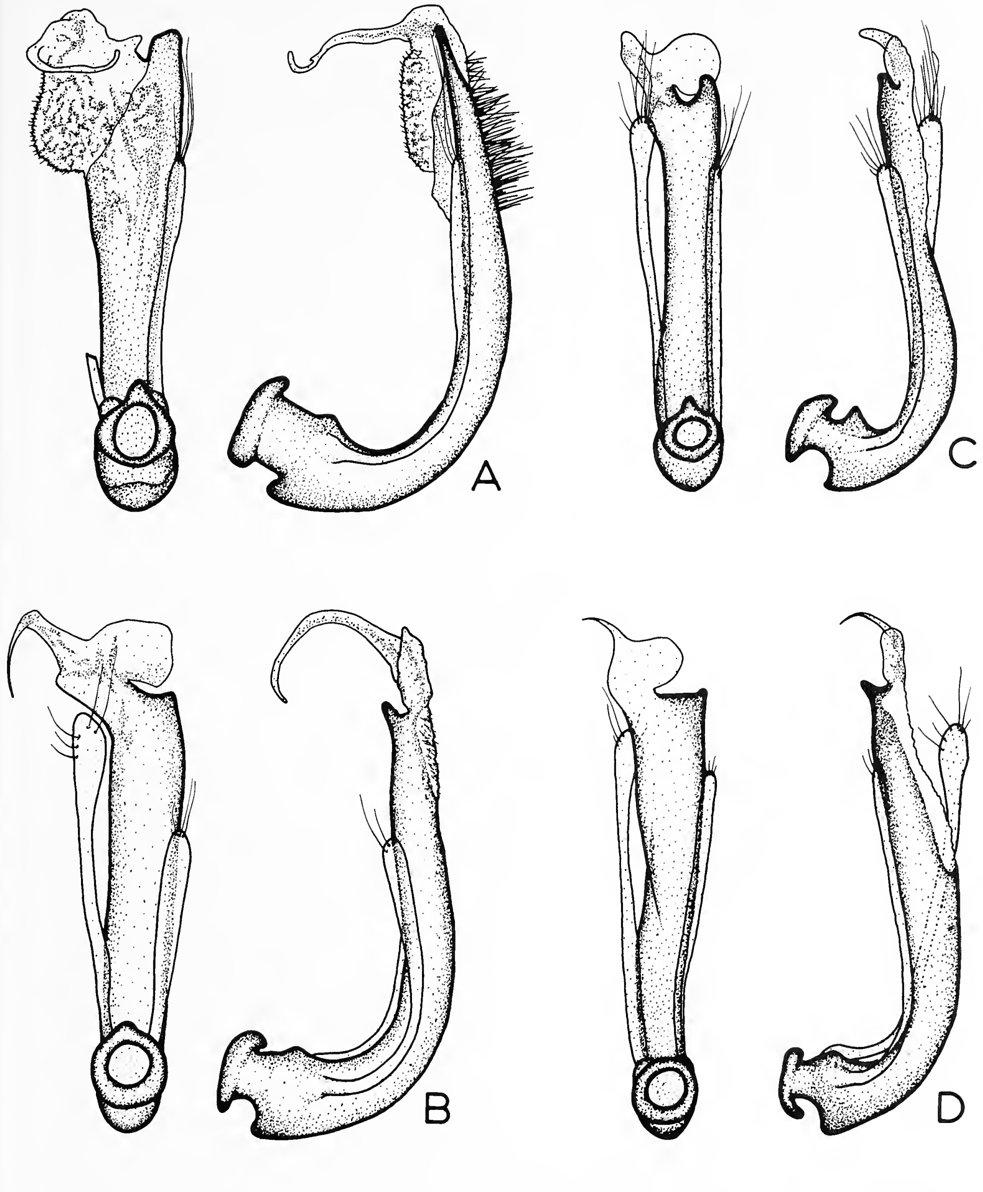
14. *Hydraena yosemitensis* new species
(Figs. 23D,28A,165A)

Type-locality. – Yosemite Falls, Mariposa County, California.

Type-specimen. – The holotype male (unique) is deposited in CAS. This specimen was collected by F. Vaillant, August 28, 1962.

Diagnosis. – Broad body form (1.78 x 0.88 mm) with very transverse pronotum, plus the short, stout legs and relatively short palpi serve to distinguish adults of *H. yosemitensis* from those of other species of the *circulata* Group.

Description. – *Form:* Broad. *Size:* Holotype 1.78 mm long, 0.88 mm wide. *Color:* Dorsal surface dark brown, nearly black. Maxillary palpi and antennae brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum, brown. *Head:* Length 0.24 mm. Width 0.48 mm. Frons punctation coarse, interstices between punctures 0.50 puncture diameter of less; microreticulation present in punctures only, absent from interstices; surface dull. Frontoclypeal suture arcuate to rear. Clypeus microreticulate. Labroclypeal suture straight across middle when viewed from above. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.22/0.08/0.14; palpomere 2 bent outward at approximately midlength; apex of palpomere 2 relatively broad; palpomere 4 broad, lateral surface slightly arcuate, medial surface more strongly arcuate, widest near midlength. Mentum wider than long, surface dull, microreticulate. Submentum microreticulate. Genae dull, microreticulate, lateral area of each gena with a well developed foveola; posterior ridge well developed. Postgena microreticulate. Last five antennomeres pubescent. Eyes slightly less than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (at approximately midlength) 0.62 mm; sides margined, denticulate; sides moderately produced at middle, straight and slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.52 mm wide, straight and nearly perpendicular to midline in lateral 0.33, slightly arcuate to rear in middle 0.33 posterior border 0.54 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola closer together than those on disc. Posteroexternal foveola strongly developed. Interfoveolar depression weakly developed. Area between external foveolae moderately elevated. Anteroexternal foveolae well developed, each foveola somewhat cresent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola moderately developed, punctures somewhat closer together than punctures on disc. Disc dull, punctures separated by 0.50 puncture diameter, microreticulation only in punctures, absent from interstices; each puncture with distinctive seta extended above cuticle in dry specimens. Scintilla absent. prosternum carinate, carina not produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae parallel; median carina not extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered; apex



Figs. 28A – D, Aedeagi of *Hydraena* holotypes. (A) *H. yosemitensis*. (B) *H. mignymixys*. (C) *H. californica*. (D) *H. petila*.

subacute, width near apex 0.33 distance between internal and median carinae. Metasternum with low ridge posterior to intercoxal process; plaques well developed, straight, convergent moderately from posterior to anterior; plaques 0.50 length of metasternum in midline; width of each plaque subequal to width of intercoxal process at its midlength; plaques separated posteriorly by approximately plaque width; plaques separated anteriorly by 0.50 plaque width; plaques flat in cross section. *Elytra:* Length 1.20 mm; maximum width (at midlength) 0.88 mm. Surface dull, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures irregular in shape, intervals not elevated, width approximately equal to puncture diameter, as are interstices between adjacent punctures of row; each puncture with seta. Explanate margin moderately developed, ended near apices, with serrations near anterior angles. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin not elevated obliquely toward suture, not in form of angle with opposite elytron. *Abdomen:* Intercoxal segment concave. Glabrous segments at apex weakly produced. Segment 7 without emargination at apex. *Legs:* Legs relatively short and stout. *Genitalia:* Aedeagus as illustrated (Fig. 28A)(1 examined).

Distribution. – (Figs. 23D,165A). Known only from the type-locality at Yosemite Falls, Yosemite National Park, Mariposa County, California.

Etymology. – Latin *yosemitensis*, in reference to the geographical distribution.

The *pennsylvanica* Complex

15. *Hydraena pennsylvanica* Kiesenwetter (Figs. 25C,29A,165B)

Hydraena pennsylvanica Kiesenwetter 1849:166 (Neotype male deposited in USNM, here designated; type-locality: Bryant Road, Emmet County, Michigan). – d'Orchymont, 1923:41.

Despite inquiries at various European museums, I was unable to find the holotype of this species, and believe that it has been destroyed. To insure taxonomic stability a neotype is herein designated.

Diagnosis. – This species is most easily confused with *H. ancylis* and *H. angulicollis*, two species with which it is sympatric in the eastern United States. Specimens of *H. pennsylvanica* can be distinguished from those of *H. ancylis* by aedeagal form and the more widely separated metasternal plaques of the latter. Most specimens of *H. pennsylvanica* can be distinguished from most specimens of *H. angulicollis* by the latter's dark color, smoother pronotum, smaller

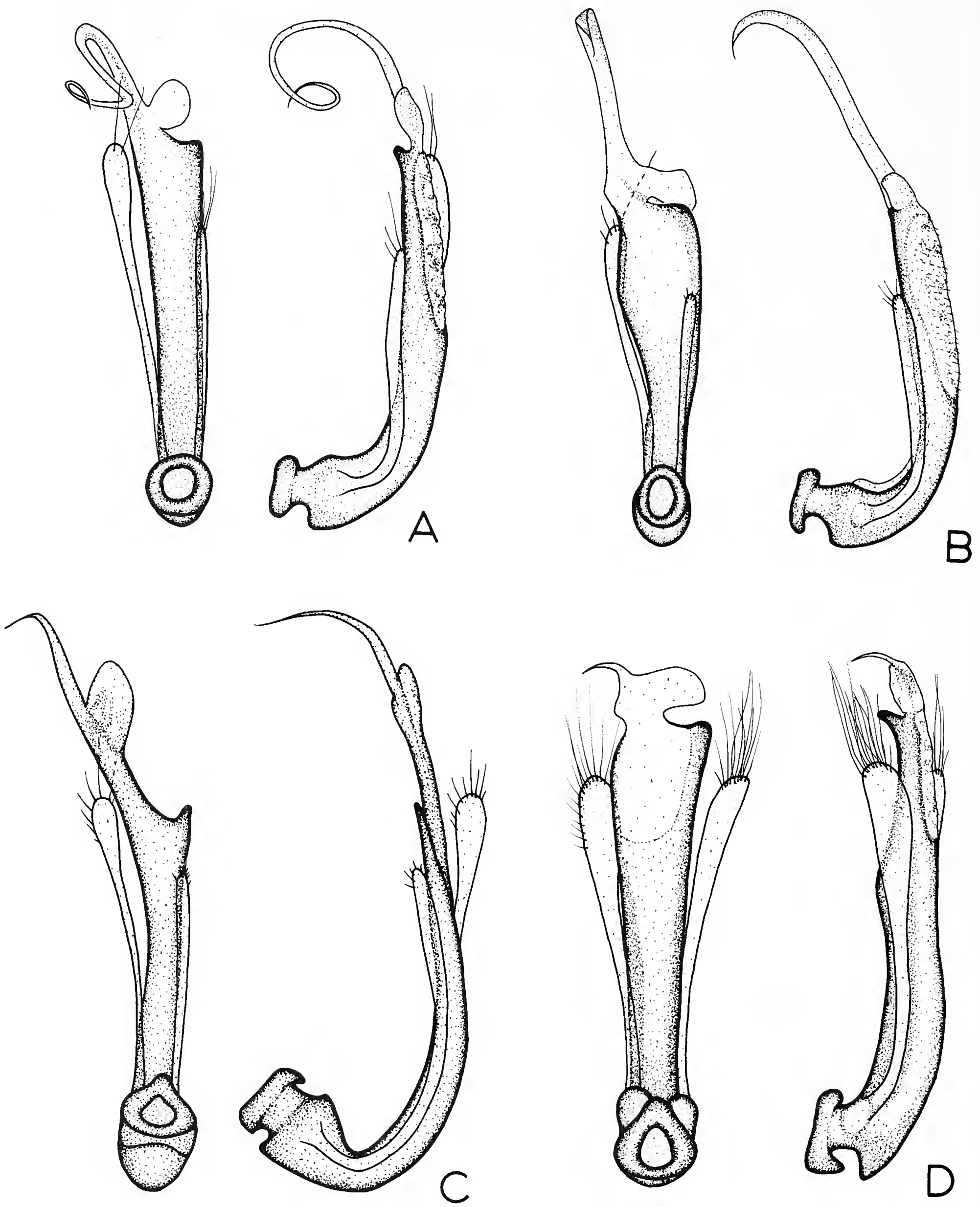
size and non-elevated elytral intervals. However, as discussed in the diagnosis and variation sections of *H. angulicollis*, certain specimens can be distinguished only by referral to aedeagal characteristics.

Description. – *Form:* Elongate oval. *Size:* Neotype 1.80 mm long, 0.80 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum dark brown except narrow testaceous border at anterior and posterior. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum, brown. *Head:* Length 0.24 mm. Width 0.40 mm. Frons punctation coarse, interstices equal to 0.50 puncture diameter; interstices shining. Frontoclypeal suture slightly arcuate to rear. Clypeus finely punctulate. Labroclypeal suture straight when viewed from above. Labrum bilobed; surface punctulate; each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.28/0.12/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral and medial surfaces weakly arcuate, widest near midlength. Mentum wider than long, surface slightly shining, finely punctulate. Submentum evenly, finely punctulate, punctures contiguous. Genae weakly shining, with several large pits; lateral area of each gena with well developed foveola; posterior ridge well developed. Postgena with punctation similar to that of submentum. Last five antennomeres pubescent. Eyes 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (at approximately midlength) 0.56 mm; sides margined, denticulate; sides moderately produced at middle, slightly sinuate and slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.46 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.56 mm wide, slightly arcuate to rear. Posterointernal foveolae very slightly developed; punctures in foveola closer together than those on disc. Posteroexternalfoveola moderately developed. Area between external foveolae nearly flat. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola weakly developed. Disc relatively dull, but with interstices shining, punctures large and deeply impressed, separated by 0.50 puncture diameter or less; each puncture with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina not produced anteriorly as very short spine; coxae separated by thin, median carina, carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina continued to base of intercoxal process; intercoxal process relatively narrow, sides tapered, apex acute, width near apex 0.25 distance between internal and median carinae. Metasternum with plaques well developed, straight, converging moderately from posterior to anterior; plaques 0.57 length of metasternum in midline; width of each plaque slightly greater than width of intercoxal process at its midlength; plaques separated posteriorly by slightly less than plaque width; plaques separated anteriorly by 0.50 plaque width; plaques flat in cross section; shallow furrow lateral to each plaque. *Elytra:* Length 1.20 mm. Maximum width (at midlength) 0.80 mm. Surface moderately shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures rectangular; intervals very slightly elevated, width approximately equal to 0.50 puncture diameter, interstices between adjacent punctures of row generally narrower; each puncture with seta. Explanate margin moderately developed, ended near apices, with serrations near anterior angles and apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin not elevated obliquely toward suture, not in form of angle with opposite elytron. *Abdomen:* Intercoxal segment concave. Glabrous segments at apex weakly produced. Segment 7 extremely weakly emarginate at apex. *Legs:* Without apparent modification. *Genitalia:* Aedeagus as illustrated (Fig. 29A)(252 examined).

Variation. – Most specimens have the pronotal puncture density midway between the more dense *H. ancylis* and the less dense *H. angulicollis*. However, at the rough extreme of its sculpture cline *H. pennsylvanica* duplicates the form seen in *H. ancylis*. Likewise, at the smooth extreme of the cline it duplicates the rough extreme of *H. angulicollis*. The aedeagus characteristic of *H. pennsylvanica* males does not vary significantly. I have examined 610 specimens (see appendix).

Natural History. – Habitat descriptors include "brook", "bog", "sifting moss", "swamp", "leaf litter using a Berlese funnel", "lake shore litter", "swamp, sphagnum", "moss on willow buttress", and "Berlese, clumps of moss and grass from swampy area overgrown with willows". The repeated occurrence of "bog" and " sphagnum" in the locality data suggest that this is the preferred habitat of *H. pennsylvanica.* detailed study of the natural history of this species is necessary to confirm this assertion.

Distribution. – (Figs. 25C,165B). Northeastern United States and adjacent Canada west to Minnesota.



Figs. 29A – D, Aedeagi of *Hydraena* species. (A) *H. pennsylvanica*, neotype. (B) *H. ancylis*, holotype. (C) *H. vandykei*. (D) *H. nigra*, holotype.

16. *Hydraena ancylis* new species
(Figs. 25D,29B,165B)

Type-locality. – Five miles NW Davidsburg, York County, Pennsylvania.

Type-specimens. – The holotype male is deposited in USNM. Paul Spangler and I collected this specimen, September 3, 1972. The allotype, which is also deposited in USNM, was collected by Paul Spangler at the same locality, July 7, 1962. Paratypes (21) are listed in the appendix.

Diagnosis. – Most adults have the pronotum slightly more coarsely punctate and the sides slightly more angulate than have adults of other eastern species of the *circulata* Group. Additionally, the plaques are usually slightly closer together than that seen in the other species with which *H. ancylis* is sympatric. Positive identification, however, should only be made after study of the aedeagus (Fig. 29B).

Description. – *Form:* Elongate oval. *Size:* Holotype 1.80 mm long, 0.76 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi brown; antennae testaceous. Pronotum dark brown except for narrow testaceous border at anterior and posterior. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum, brown. *Head:* Length 0.24 mm. Width 0.46 mm. Frons punctation coarse, narrow walls separating punctures; microreticulation in punctures only, absent from interstices; surface dull. Frontoclypeal surface slightly arcuate to rear. Clypeus microreticulate. Labroclypeal suture straight across middle in dorsal aspect. Labrum bilobed, microreticulate; each lobe asymmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.32/0.12/0.24; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; apical segment with lateral and medial surfaces slightly arcuate; apical segment widest near apical 0.33. Mentum wider than long, surface dull, finely microreticulate. Submentum microreticulation similar to mentum. Genae dull, finely microreticulate; area of each gena with well developed foveola; posterior ridge well developed. Postgena with microreticulation smaller than that of submentum. Last five antennomeres pubescent. Eyes slightly greater than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0,42 mm; maximum width (at approximately midlength) 0.60 mm; sides margined, denticulate; sides moderately produced at middle, slightly sinuate and slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.50 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.52 mm wide, slightly arcuate to rear. Posterointernal foveolae slightly developed; punctures in foveola closer together than those on disc. Posteroexternal foveola moderately developed. Interfoveolar depression slightly developed. Area between external foveolae nearly flat. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola very slightly developed, with punctures somewhat closer together than punctures on disc. Disc dull, punctures separated by thin walls; each puncture with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina not produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina not extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered, apex subacute, width near apex 0.50 distance between internal and median carinae. Metasternum with plaques well developed, lateral margins parallel, medial margins weakly arcuate away from midline; plaques 0.50 length of metasternum in midline; width of each plaque subequal to width of intercoxal process at its midlength; plaques separated anteriorly and posteriorly by approximately plaque width; plaques flat in cross section. *Elytra:* Length 1.24 mm. Maximum width (at midlength) 0.76 mm. Surface dull, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures rectangular, intervals elevated, width approximately equal to 0.33 puncture width, as are interstices between adjacent punctures of a row; surface of each interval uneven, reflections interrupted; each puncture with seta. Explanate margin moderately developed, ended near apices, with serrations along entire margin, those in anterior and posterior 0.33 quite prominent. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin not elevated obliquely toward suture, not in form of angle with opposite elytron. *Abdomen:* Intercoxal segment concave. Glabrous segments at apex slightly produced. Segment 7 without emargination at apex. *Legs:* Without apparent modification. *Genitalia:* Aedeagus as illustrated (Fig. 29B)(13 examined).

Variation. – Some specimens have a rather distinctive ochraceous coloration of the pronotum.

Natural History. – The stream at the type-locality was very small, probably spring-fed. The margin, where the beetles were found, was composed mostly of gravel and had slightly elevated, grassy banks. Other locality data indicate "pond" and "*Sphagnum*" habitats.

Distribution. – (Figs. 25D,165B). From Maryland west to Indiana and Missouri, then south to Louisiana and southeasternmost Texas.

Etymology. – Greek *ankylis* (hook). This name refers to the hook-shaped apex of the aedeagus.

Remarks. – The Texas locality of *H. ancylis* represents the southernmost known point of distribution for the *circulata* Group.

17. *Hydraena vandykei* d'Orchymont (Figs. 23C,29C,165B)

Hydraena vandykei d'Orchymont 1923:42 (holotype male in ISNB; type-locality: Rossvail, Marin County, California). – Leech and Chandler, 1956:333.

Diagnosis. – Distinguished from other members of the *circulata* Group, except *H. sierra*, by the generally lighter color, slightly smaller pronotum with the lateral depressed areas more explanate and the sides slightly more incised at the rear, and, especially, the rather long, dense pubescence lateral to each metasternal plaque. The aedeagus is distinctive and must be studied to differentiate males of *H. vandykei* and *H. sierra*.

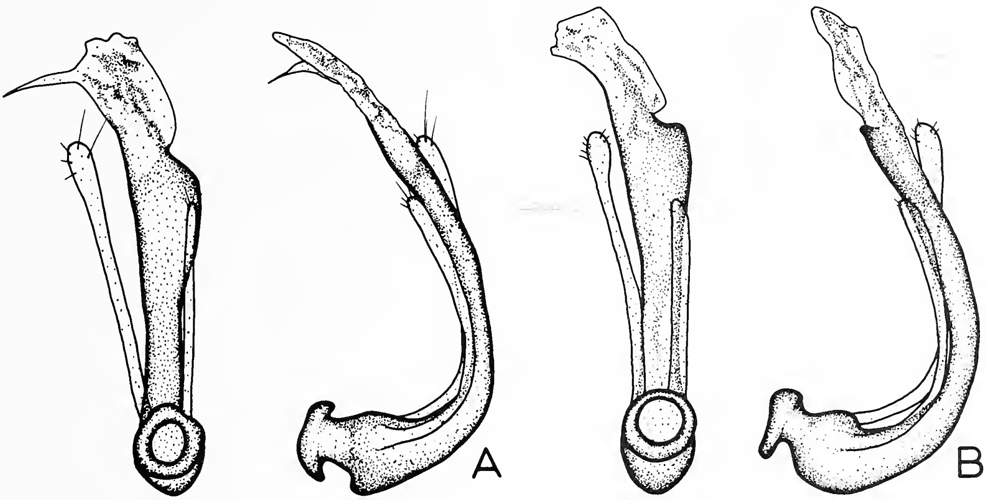
Description. – *Form:* Elongate. *Size:* Holotype 1.88 mm long, 0.76 mm wide. *Color:* Dorsal surface brown. Maxillary palpi and antennae testaceous. Ventral surface dark brown except legs, elytral epipleurae and inflexed margin of pronotum, brown. *Head:* Length 0.24 mm. Width 0.42 mm. Frons dull, punctation coarse, some punctures confluent, microreticulation most evident near eyes and in punctures. Frontoclypeal suture arcuate to posterior. Clypeus microreticulate. Labroclypeal suture straight in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively;0.28/0.12/0.24; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, arcuate in apical 0.66, median surface arcuate; apical segment widest near apical 0.33. Mentum wider than long, surface moderately shining, finely microreticulate. Submentum microreticulate. Genae moderately shining, microreticulate, lateral area of each gena with well developed foveola; posterior ridge well developed. Postgena microreticulate. Last five antennomeres pubescent. Eyes 0.17 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (at approximately midlength) 0.54 mm; sides margined, denticulate; sides well produced at middle, slightly sinuate and slightly convergent to anterior angle, strongly sinuate and convergent to posterior; anterior border 0.44 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.44 mm wide, slightly arcuate to rear. Posterointernal foveolae well developed; anterior region of each foveola nearly confluent with interfoveolar depression; punctures in foveola confluent. Antero- and posteroexternal foveolae confluent; side of pronotum explanate. Transversal foveola well developed, with some punctures confluent. Disc dull, punctures microreticulate, large, separated by thin walls, most punctures with seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina not produced anteriorly as very short spine; coxae separated by median carina slightly wider than norm; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad, sides tapered; apex round, width near apex 0.66 distance between internal and median carinae. Metasternum with plaques well developed, weakly arcuate in posterior 0.50, convergent from posterior to anterior; plaques 0.57 length of metasternum in midline; width of each plaque 0.33 width of intercoxal process at midlength; plaques separated posteriorly by approximately three times plaque width; plaques separated anteriorly by plaque width; plaques round in cross section; area lateral to each plaque with relatively dense and long pubescence which overlaps lateral margin of each plaque slightly. *Elytra:* Length 1.24 mm, maximum width (at midlength) 0.76 mm. Surface dull, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures rectangular; intervals not elevated, width approximately equal to 0.33 puncture diameter, as are interstices between adjacent punctures of a row; each puncture with seta. Explanate margin moderately developed, ended near apices, with extremely fine, well separated serrations along entire margin; serrations somewhat closer near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment concave. Glabrous segments at apex very weakly produced. Segment 7 without emargination at apex. *Legs:* Without apparent modification. *Genitalia:* Aedeagus as illustrated (Fig. 29C)(176 examined).

Natural History. – Most locality records cite "stream" or "creek" as habitat. This species is primarily a psammophilous lotic form; for a detailed discussion of the microhabitat preferences of *H. vandykei* and its habitat associates, refer to Perkins (1976)(*H. vandykei* and *H. circulata*

are discussed in that paper under the designation "*Hydraena* sp."). Unusual habitat descriptors seen during this study include the following, all due to the careful observation of Hugh B. Leech: "foul pool, dried bed of creek", "roadside seepage", "clear water pools in gravel and stones of otherwise dry and shaded creekbed", and "moss-edged rock pools in running stream, open area".

Distribution. – (Figs. 23C,165B). Coastal mountain ranges of California. One locality is known from Vancouver, British Columbia, but no specimens are yet known from the intervening states of Washington and Oregon. A total of 378 specimens were examined (see appendix).

Remarks. – The aedeagus of the holotype is distorted due to being mounted on a microslide by a previous worker. I have therefore used another specimen to prepare the illustration.



Figs. 30A – B, Aedeagi of *Hydraena sierra.* (A) holotype (B) variant from Portland, Oregon.

18. *Hydraena sierra* new species
(Figs. 23F,30A,B,165B)

Type-locality. – North Fork San Joaquin River, at Sheep Crossing, 6000 feet, Madera County, California.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in CAS. Hugh B. Leech collected these specimens, August 22, 1971. Paratypes (16) are listed in the appendix.

Diagnosis. – Adults of *H. sierra* are distinguished from all members of the *circulata* Group, except *H. vandykei*, by the relatively long and dense hydrofuge pubescence lateral to each metasternal plaque. Aedeagi must be studied to differentiate males of *H. sierra* and *H. vandykei*.

Description. – *Form:* Elongate. *Size:* Holotype 1.84 mm long, 0.76 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi brown; antennae testaceous. Pronotum dark brown except narrow brown border. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum, brown. *Head:* Length 0.24 mm. Width 0.44 mm. Frons dull, punctation coarse, punctures separated by narrow walls; microreticulation in punctures, absent from interstices. Frontoclypeal suture straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe asymmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.30/0.12/0.24; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, arcuate in apical 0.66, median surface arcuate, apical segment widest near apical 0.33. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulate. Genae dull, finely microreticulate, lateral area of each gena with a well developed foveola; posterior ridge well developed. Postgena with microreticulation slightly smaller than that of submentum. Last five antennomeres pubescent. Eyes 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (at approximately midlength) 0.54 mm; sides margined, denticulate; sides well produced at middle, slightly sinuate and slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.46 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.46 mm. wide, slightly arcuate to rear. Posterointernal foveolae well developed, anterior region of each foveola nearly confluent with interfoveolar depression; punctures in foveola confluent. Antero- and posteroexternal foveolae confluent, producing explanate sides of pronotum. Disc dull, punctation coarse, punctures separated by thin walls; microreticulation in larger punctures, absent from interstices; most punctures with distinctive seta extended above cuticle in dry specimens. Scintilla absent. prosternum carinate, carina not produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina not extended to base of intercoxal process; intercoxal process relatively broad, sides tapered, apex round, width near apex 0.66 distance between internal and median carinae. Metasternum with plaques well developed, slightly arcuate away from midline in posterior 0.50, convergent moderately from posterior to anterior; plaques 0.57 length of metasternum in midline; width of each plaque 0.33 width of intercoxal process at its midlength; plaques separated posteriorly by approximately three times plaque width; plaques separated anteriorly by twice plaque width; plaques round in cross section; area lateral to each plaque with relatively dense and long pubescence which overlaps lateral margin of each plaque slightly. *Elytra:* Length 1.24 mm. Maximum width (at midlength) 0.76 mm. Surface dull, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures rectangular; intervals not elevated, width approximately equal to 0.33 puncture diameter, as are interstices between adjacent punctures of a row; intervals and interstices with uneven surface, reflections interrupted; punctures with seta. Explanate margin moderately developed, ended near apices, with serrations near anterior angles and apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment concave. Glabrous segments at apex weakly produced. Segment 7 without emargination at apex. *Legs:* Without apparent modification. *Genitalia:* Aedeagus as illustrated (Figs. 30A-B)(9 examined).

Variation. – The specimens from the Sierra Nevada Mountains are quite homogeneous. I have seen one male from Portland, Oregon which I am tentatively assigning to this species. The aedeagus of this specimen (Fig. 30B) differs slightly from the aedeagi of the Sierran specimens. Externally, this specimen is shorter, slightly broader, darker and has the elytral series less regular. This specimen may represent another species, but such a decision must be deferred until more material becomes available from Oregon and Washington.

Natural History. – *H. sierra*, like its putative sister-species *H. vandykei*, is probably a lotic psammophile. Its distribution in the Sierra Nevada Mountains and its close relationship to *H. vandykei* justifies this supposition; available locality data are not definitive in regard to habitat.

Distribution. – (Figs. 23F,165B). Sierra Nevada Mountains of California. One questionable specimen known from Portland, Oregon.

Etymology. – Spanish (but seemingly Latin) noun in apposition, *sierra*, in reference to the Sierra Nevada Mountains of California.

The *leechi* Group

Leechi Group adults are characterized by possession of posterointernal foveolae on the pronotum (Figs. 31C,48C). In addition, the genae lack a posterior ridge ((Fig. 48E), and the intercoxal segment of the abdomen is flat and generally with a straight posterior margin

(Fig. 48D).

The aedeagus is extremely varied among males of the *leechi* Group, variations including origin of parameres, shape of parameres, shape of main-piece, and shape of terminal mobile piece, when present.

Externally the group is quite diverse also, variations including shape of the pronotum, development of a scintilla, development of microsculpture, patterns of elytral punctation, shape of plaques, distance separating coxae, and various leg modifications (among others).

Geographically the group is very widespread, ranging from northern Argentina to southern and northeastern United States (Fig. 160).

The *leechi* Subgroup

Adults included in the *leechi* Subgroup are relatively large, about 1.50 to 2.05 mm long, and both sexes have a well developed scintilla (Figs. 31C,E). Males have occipital ridges (Figs. 31D,32C), above which extends the scintilla, and also have arcuate hind tibiae which are provided with a prominent brush of hairs in the distal 0.50 (Figs. 32D-G). Infrequently the hind tibiae are expanded in addition to having the brush of hairs. Similarity of the basic aedeagal form (Figs. 33A-D), which is broad in both views and has flat, lobate parameres, provides further corroboration for the monophyly here proposed.

Individuals of this group are known from the mountains of the southwestern United States south through the ranges of the Sierra Madre Occidental to the mountains of Oaxaca, Mexico. Seven species are currently included in the *leechi* Subgroup.

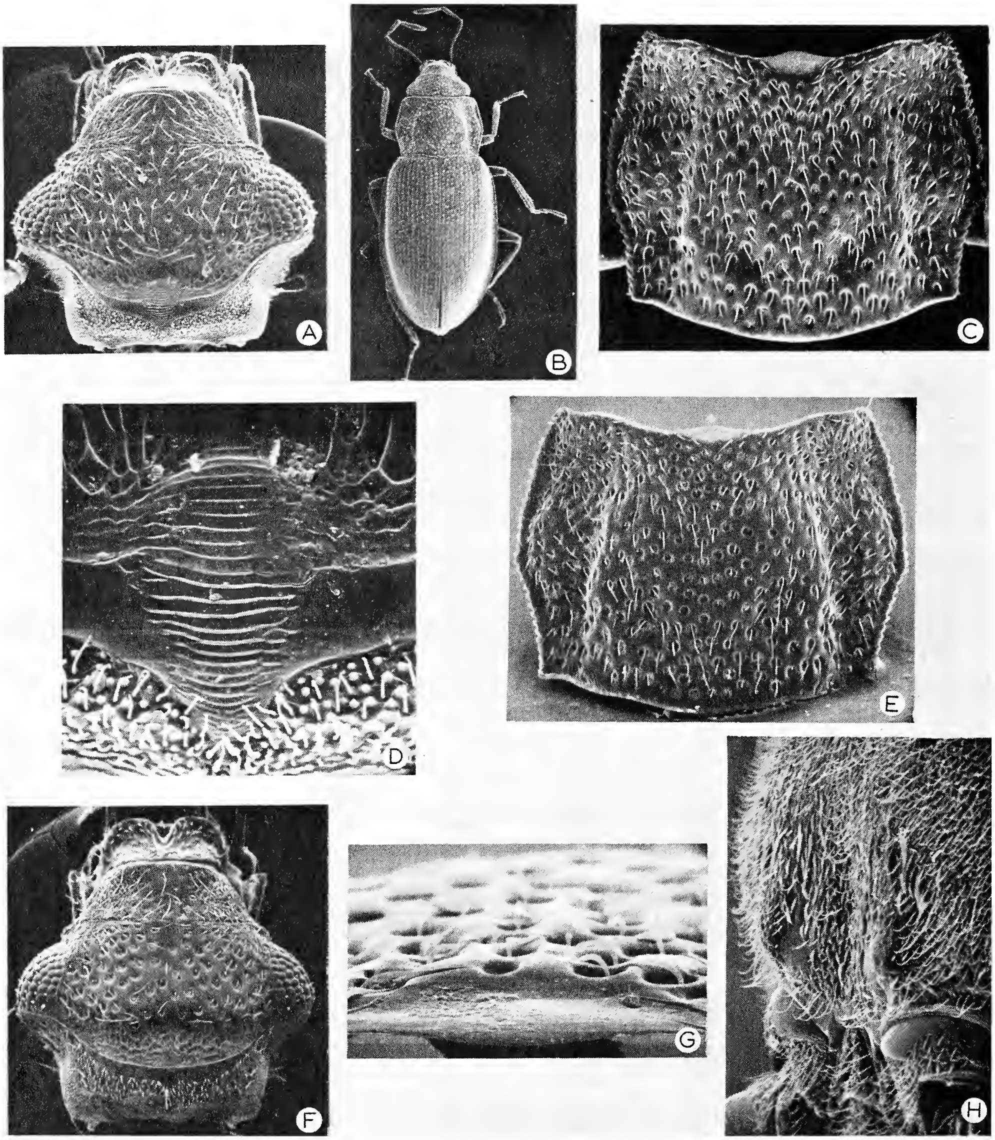
19. *Hydraena leechi* new species
(Figs. 33A,34A,166)

Type-locality. – Oak Creek Canyon, Midgley Bridge, Coconino County, Arizona.

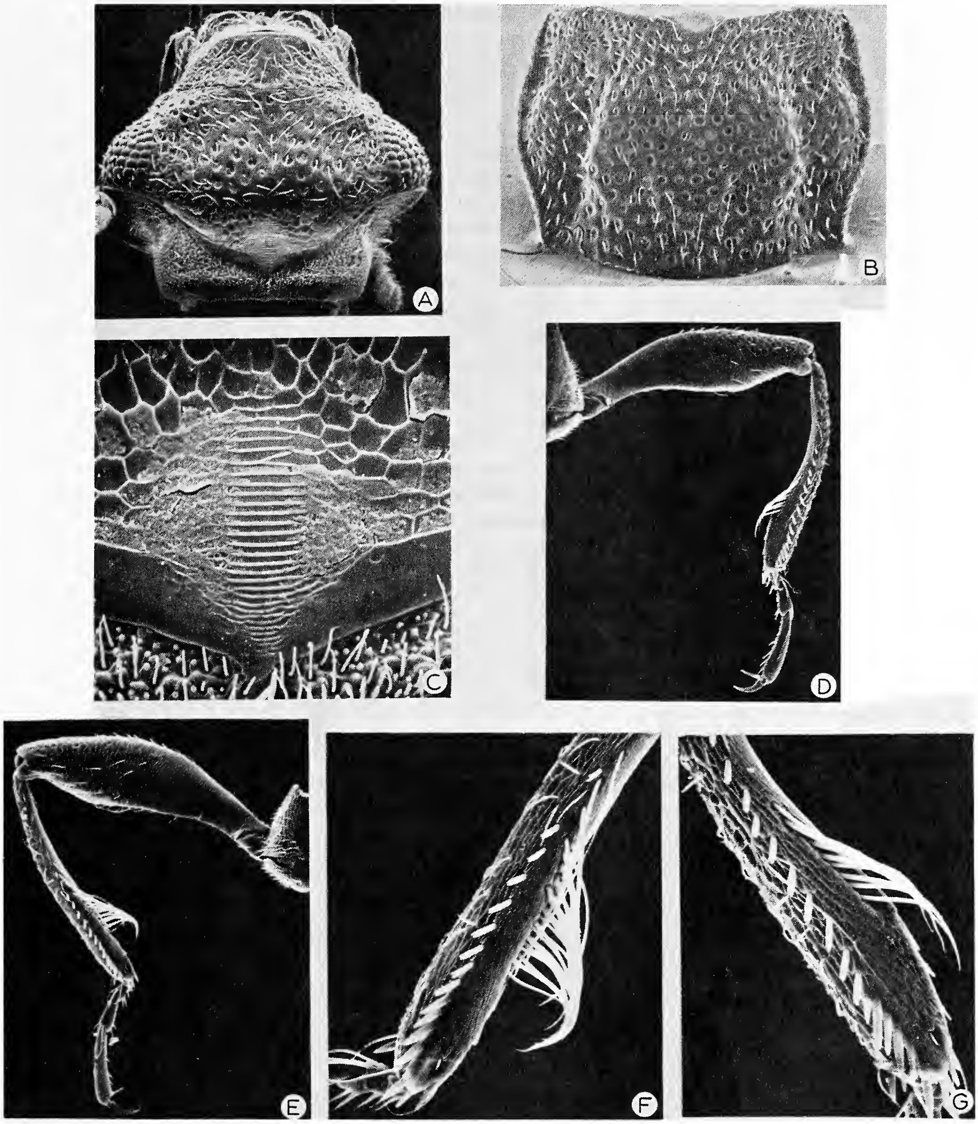
Type-specimens. – The holotype male and allotype with same data are deposited in CAS. These specimens were collected by Hugh B. Leech, August 25, 1952. Paratypes (180) are listed in the appendix.

Diagnosis. – Specimens of *H. leechi* from the eastern part of its range (Fig. 34A) are easily distinguished, being the only *Hydraena* with posterointernal foveolae, a large scintilla, and males with a brush of hairs on the metatibiae. In Arizona, *H. leechi* is readily distinguished from *H. bituberculata* and *H. arizonica*, both of which have posterointernal foveolae and a large scintilla, by the form of the plaques, which are absent or reduced to small ovals in *H. leechi*, tuberculate laterally in *H. bituberculata* (Figs. 31H,35B), and carinate in *H. arizonica* (Fig. 35A). Additionally, the metatibiae of *H. arizonica* males are expanded in the region of the brush of hairs (Figs. 32D,G); males of *H. leechi* have the metatibiae gradually enlarged from base to apex (Figs. 32E-F). To reliably differentiate males of *H. leechi* from those of *H. scopula*, the aedeagi must be removed and studied. *H. scopula*, however, is known only from Jalisco, Mexico, which is far south of the known southwestern distributional limit of *H. leechi*.

Description. – *Form:* Elongate-oval. *Size:* Holotype 1.80 mm long, 0.76 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi brown; antennae brown. Pronotum dark brown except anterior and posterior borders slightly lighter. Elytra brown, near color of anterior and posterior borders of pronotum. Ventral surface dark brown. *Head:* Length 0.24 mm. Width 0.44 mm. Frons coarsely punctured, interstices approximately 0.50 puncture diameter; interstices shining; posterior margin emarginate in midline to receive scintilla. Frontoclypeal suture straight.



Figs. 31A – H, *Hydraena bituberculata*. (A) head of ♂, dorsal aspect. (B) dorsal habitus. (C) pronotum of ♂. (D) occipital ridges of ♂. (E) pronotum of ♀. (F) head of ♀, dorsal aspect. (G) pronotal scintilla, anterior view. (H) metasternum, oblique view.



Figs. 32A – G, *Hydraena arizonica* and *H. bituberculata*. (A) *H. arizonica*, dorsum of head, ♂. (B) *H. arizonica*, ♂ pronotum. (C) *H. arizonica*, occipital ridges of ♂. (D) *H. arizonica*, hind leg of ♂. (E) *H. bituberculata*, hind leg of ♂. (F) *H. bituberculata*, hind tibia of ♂. (G) *H. arizonica*, hind tibia of ♂.

Clypeus microreticulate. Labroclypeal suture nearly straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.32/0.16/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface arcuate in basal 0.33, slightly expanded at apical 0.66, median surface sinuate; apical segment widest at midlength. Mentum wider than long, surface moderately shining, finely punctulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge very slightly developed. Postgena with microreticulation slightly larger than that of submentum. Antennae with last 5 segments pubescent. Eyes slightly less than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (slightly before midlength) 0.56 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and convergent to anterior angles, very slightly sinuate and moderately convergent to posterior; anterior border 0.46 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.50 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola similar to those on disc. Posteroexternal foveola well developed. Interfoveolar depression well defined, discal area elevated. Area between external foveolae moderately elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extends across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola slightly developed, with punctures somewhat closer together than punctures on disc. Disc moderately shining, punctures relatively large and deeply impressed, separated by thin ridges near anterior and posterior borders, by 0.50 puncture diameter in middle; punctures with distinctive setae extended above cuticle in dry specimens. Scintilla distinct, flat, impunctate shelf with arcuate anterior and posterior margins. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides parallel, apex rounded, width 0.33 distance between internal and median carinae. Metasternum without plaques. *Elytra:* Length 1.20 mm. Maximum width (at midlength) 0.76 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.50 puncture diameter, interstices between adjacent punctures of row generally narrower; punctures each with seta. Explanate margin quite narrow, with extremely fine, well separated serrations near anterior angles and apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin arcuate. Glabrous segments at apex moderately produced, length subequal to that of metasternum in midline. Apical segment slightly emarginate at apex. *Legs:* Profemur with small tubercle on inner surface near basal 0.33. Protibia very slightly arcuate, prominent spine on inner surface at apical 0.33. Metafemur broad, lateral surface markedly arcuate, median surface sinuate. Metatibiae gradually enlarged from base to apex; arcuate in basal 0.50; with prominent brush of hairs at apical 0.33. *Genitalia:* Aedeagus as illustrated (Fig. 33A)(92 examined).

Variation. – No significant variation was noted in the 180 specimens studied.

Natural History. – The scant habitat data available include the notations, "in moss and grass roots along stream", "along creek edge", "spring", and "pools, bed below Yank's Spring".

Distribution. – (Figs. 34A,166). Southeastern Arizona south to northwestern Mexico and east to southern Oklahoma.

Etymology. – It is with great pleasure that I dedicate this species to Hugh B. Leech, in recognition of his many contributions to the study of aquatic beetles in general, and to this study in particular.

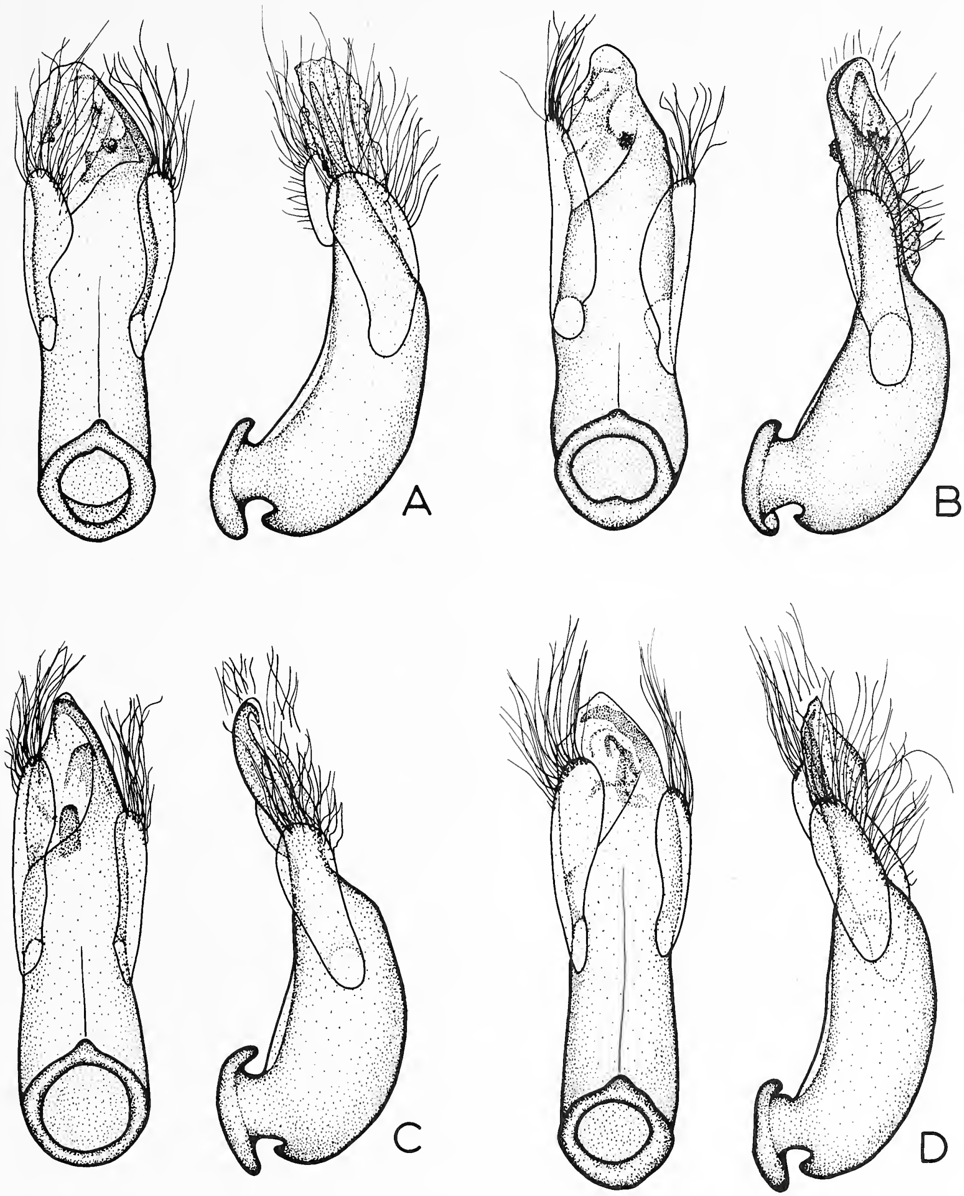
20. *Hydraena breedlovei* new species
(Figs. 33B,166)

Type-locality. – Two miles E. of Durango-Sinaloa boundary on highway MEX. 40, 7000 feet, Durango, Mexico.

Type-specimens. – The holotype male and allotype with same data are deposited in CAS. These specimens were collected by D.E. Breedlove and J.F. Copp on December 30, 1962. Paratypes (34) are listed in the appendix.

Diagnosis. – Small size (1.48 mm long), strongly arcuate metatibiae which are provided with a brush of hairs in males, and moderately broad form serve to characterize this species. Plaques are thin arcuate lines, barely distinguishable, not shiny and therefore not contrasting

with remainder of metasternum; they are, however, very slightly elevated in males.



Figs. 33A – D, Aedeagi of *Hydraena* holotypes. (A) *H. leechi*. (B) *H. breedlovei*. (C) *H. arizonica*. (D) *H. bituberculata*.

Description. – *Form:* Subovate. *Size:* Holotype 1.48 mm long, 0.64 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi brown; antennae brown. Pronotum with disc dark brown, lateral areas lighter. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum, brown. *Head:* Length 0.20 mm. Width 0.40 mm. Frons coarsely punctured, interstices less than puncture diameter; interstices shining; posterior margin emarginate in midline to receive scintilla. Frontoclypeal suture straight. Clypeus microreticulate.

Labroclypeal suture nearly straight across in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively; 0.24/0.10/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight; median surface arcuate; apical segment widest at midlength. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge imperceptible. Postgena with punctation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (slightly before midlength) 0.54 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and moderately convergent to anterior angle, very slightly sinuate and moderately convergent to posterior; anterior border 0.42 mm wide, straight and nearly perpendicular to midline in lateral 0.25; slightly arcuate to rear in middle 0.50; posterior border 0.46 mm wide, slightly arcuate to rear. Posterointernal foveolae slightly developed; punctures in foveola similar to those on disc. Posteroexternal foveola well developed. Interfoveolar depression relatively shallow. Area between external foveolae moderately elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, occupying slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc slightly shining, punctures coarse, separated by thin ridges near anterior and posterior borders, and 0.50 puncture diameter or less in middle; punctures with distinctive setae extended above cuticle in dry specimens. Larger interstices with minute reflections, cuticle with appearance of tiny reflecting surfaces within. Scintilla distinct, flat, impuntate shelf with arcuate anterior and posterior margins. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel, apex blunt, width at apex 0.33 distance separating internal and median carinae. Metasternum with plaques weakly developed, arcuate, convergent rather markedly from posterior to anterior; plaques nearly 0.50 length of metasternum in midline; each plaque thin, moderately elevated ridge. *Elytra:* Length 1.00 mm. Maximum width (at midlength) 0.64 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately 0.50 puncture diameter, interstices between adjacent punctures of row generally narrower; punctures each with seta. Explanate margin quite narrow, ended near posterior 0.17, with extremely fine, well separated serrations near anterior angles and apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex moderately produced. Apical segment without emargination at apex. *Legs:* Profemur with minute tubercle on inner surface near basal 0.33. Protibia slightly arcuate, prominent spine on inner surface at apical 0.33. Metafemur broad; lateral surface markedly arcuate; median surface sinuate. Metatibia slightly expanded, with prominent brush of hairs at apical 0.33; basal 0.50 arcuate. *Genitalia:* Aedeagus as illustrated (Fig. 33B)(17 examined)

Natural History. – I have collected adults of this species from sand and gravel at the margin of a stream flowing through a pine forest in the mountains of Durango, Mexico.

Distribution. – (Fig. 166). As presently known, restricted to the mountains of Durango, Mexico.

Etymology. – It is my pleasure to acknowledge the request of Hugh Leech, who had recognized this species as undescribed, and to dedicate it to D. E. Breedlove, Chairman of the Department of Botany, California Academy of Sciences.

21. *Hydraena arizonica* new species
(Figs. 10J,32A-D,G,33C,34A,35A,166)

Type-locality. – Madera Canyon, 6200 feet, Santa Rita Mountains, Santa Cruz County, Arizona.

Type-specimens. – The holotype male and allotype with identical data are deposited in CAS. These specimens were collected by Hugh B. Leech, August 1, 1952. Paratypes (47) are listed in the appendix.

Diagnosis. – Straight, carinate plaques (Fig. 35A) serve to readily distinguish specimens of *Hydraena arizonica* from other species whose adults also possess a well developed scintilla. Additionally, males have the metatibiae expanded and with a brush of hairs (Figs. 32D,G).

Description. – *Form:* Elongate. *Size:* Holotype 1.76 mm long, 0.72 mm wide. *Color:* Dorsal surface dark brown; maxillary palpi brown; antennae brown. Ventral surface dark brown except legs brown. *Head:* Length 0.20 mm. Width 0.40 mm. Frons coarsely punctured, interstices usually less than 0.50 puncture diameter; interstices shining; posterior margin emarginate in midline to receive scintilla. Labroclypeal suture straight. Clypeus microreticulate. Labroclypeal suture weakly arcuate when viewed from above. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.24/0.12/0.18; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface arcuate in basal 0.33, slightly expanded at apical 0.66, median surface sinuate; palpomere 4 widest at midlength. Mentum wider than long, surface moderately shining, finely punctulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge nearly imperceptible. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0,44 mm; maximum width (slightly before midlength) 0.56 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and slightly convergent to anterior angle, very slightly sinuate and convergent to posterior; anterior border 0.46 mm wide, straight and nearly perpendicular to midline in lateral 0.25, slightly arcuate to rear in middle 0.50; posterior border 0.48 mm wide, slightly arcuate to rear. Posterointernal foveolae well developed; punctures in foveola similar to those on disc. Posteroexternal foveola well developed. Interfoveolar depression well defined, discal area elevated. Area between external foveolae moderately elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc slightly shining, punctures relatively large and deeply impressed, separated by thin ridges near anterior and posterior borders, and 0.50 puncture diameter or less in middle; punctures with setae extended above cuticle in dry specimens. Larger interstices with minute reflections, cuticle apparently with tiny reflecting surfaces within. Scintilla distinct, flat, impunctate shelf with arcuate anterior and posterior margins. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides parallel, apex blunt, width at apex 0.33 distance between internal and median carinae. Metasternum with plaques moderately developed, straight, convergent very slightly from posterior to anterior; plaques nearly 0.50 length of metasternum in midline; each plaque thin, moderately elevated ridge. *Elytra:* Length 1.12 mm. Maximum width (at midlength) 0.72 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.50 puncture diameter, as are interstices between adjacent punctures of a row; punctures each with perceptible seta. Explanate margin quite narrow, ended near posterior 0.17, with extremely fine, well separated serrations near anterior angles and apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex moderately produced. Apical segment without emargination at apex. *Legs:* Profemur with small tubercle on inner surface near basal 0.33. Protibia very slightly arcuate, prominent spine on inner surface at apical 0.33. Metafemur broad, lateral surface markedly arcuate, median surface sinuate. Metatibia expanded and with brush of hairs on inner surface near apical 0.25, basal 0.50 arcuate. *Genitalia:* Aedeagus as illustrated (Fig. 33C)(27 examined).

Natural History. – Locality data include the notations "along creek edge" and "ex under stones in small creek in mountains, 2500 meters".

Distribution. – (Figs. 34A,166). Known from the mountains of southeastern Arizona and Durango, Mexico.

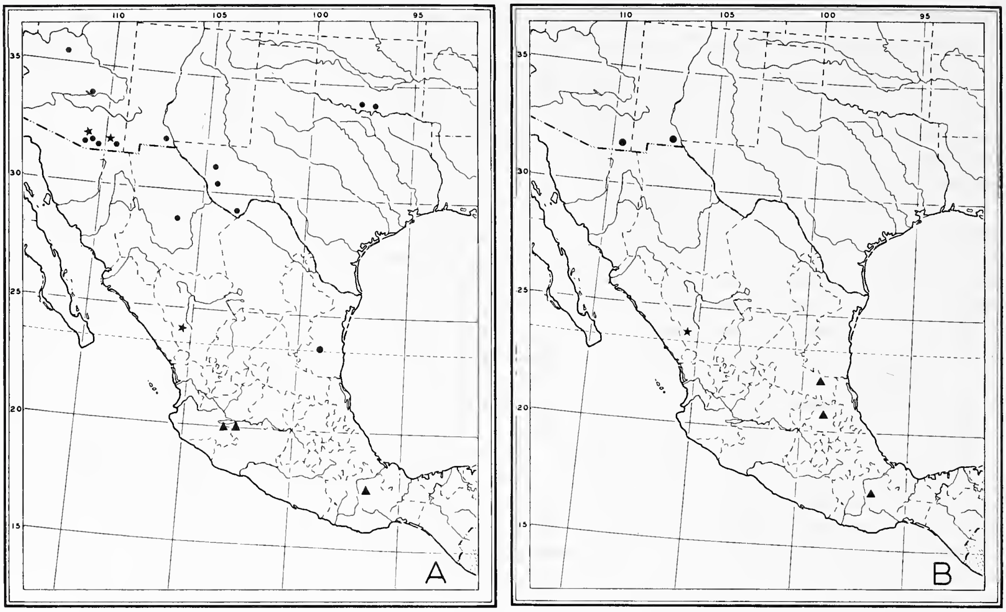
Etymology. – Latin, *arizonica*, in reference to location of the type locality.

22. *Hydraena bituberculata* new species
(Figs. 31A-H,32E-F,33D,34B,35B-C,166)

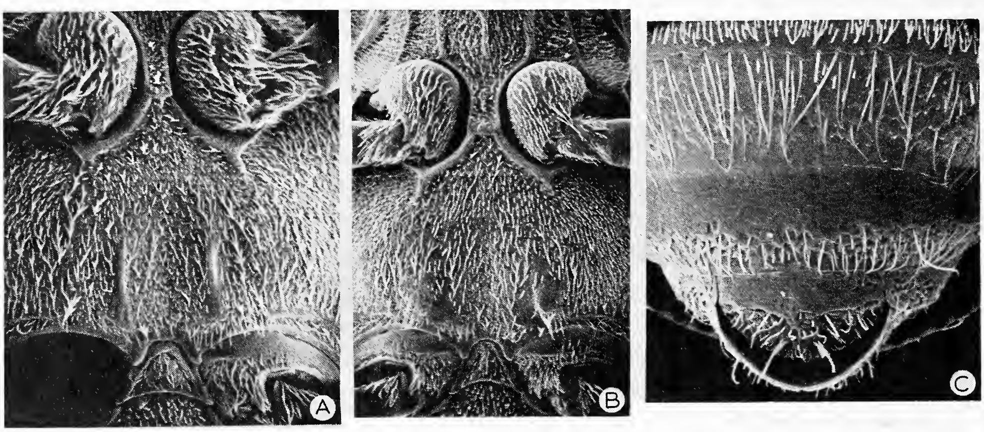
Type-locality. – South Fork Cave Creek, 4.5 miles W. Portal, Cochise County, Arizona.

Type-specimens. – The holotype male is deposited in CAS. This specimen was collected by Hugh B. Leech, July 30, 1965. The allotype, also deposited in CAS, was collected by P. H. Arnaud, Jr. at the Southwest Research Station in the same county, October 24, 1964. Paratypes (52) are listed in the appendix.

Diagnosis. – Among those species with a well developed scintilla, *H. bituberculata* is unique in possession of a tubercle lateral to each metasternal plaque. (Figs. 31H,35B). Males have a well developed brush of hairs on the metatibiae.



Figs. 34A – B, Geographical distributions of *Hydraena* species. (A) *H. leechi* ●, *H. arizonica* ★ and *H. scopula* ▲. (B) *H. bituberculata* ●, *H. alternata* ★ and *H. scintilla* ▲.



Figs. 35A – C. (A) *Hydraena arizonica*, metasternum. (B) *H. bituberculata*, metasternum. (C) *H. bituberculata*, ♀ abdominal apex.

Description. – *Form:* Elongate. *Size:* Holotype 1.92 mm long, 0.76 mm wide. *Color:* Head with dorsal surface dark brown; labrum brown; maxillary palpi brown; antennae testaceous. Pronotum with disc dark brown, lateral areas lighter. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum, brown. *Head:* Length 0.24 mm. Width 0.44 mm. Frons coarsely punctured, interstices in midline equal to or slightly greater than puncture diameter; surface shining; posterior margin emarginate in midline to receive scintilla. Frontoclypeal suture straight. Clypeus finely microreticulate at sides, glabrous in midline. Labroclypeal suture nearly straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended slightly before midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.28/0.16/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface very slightly arcuate 0.33, very slightly expanded at apical 0.66, median very slightly sinuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge slightly developed. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (at approximately midlength) 0.60 mm; sides margined, denticulate; sides moderately produced at middle, nearly straight and convergent to anterior angle, very slightly concave and convergent to posterior; anterior border 0.48 mm wide, straight and nearly perpendicular to midline in lateral 0.20, moderately arcuate to rear in middle 0.60; posterior border 0.52 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola similar to those on disc. Posteroexternal foveola well developed. Interfoveolar depression well defined, discal area elevated. Area between external foveolae moderately elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola slightly developed, punctures separated by narrow ridges. Disc shining, punctures relatively large and deeply impressed, separated by thin ridges near anterior and posterior borders, by puncture diameter in middle; punctures with distinctive seta extended above cuticle in dry specimens. Scintilla distinct, flat, impunctate shelf with arcuate hind margin. Prosternum carinate, carina produced anteriorly into very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent slightly from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, increased very slightly in width from base to apex, apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with prominent tubercle immediately lateral to each plaque; each plaque small oval at posterior 0.25 of metasternum. *Elytra:* Length 1.22 mm. Maximum width (at midlength) 0.76 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.50 puncture diameter, interstices generally narrower; punctures each with perceptible seta. Explanate margin quite narrow, ending near posterior 0.17, with extremely fine, well separated serrations near anterior angles and apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin arcuate. Glabrous segments at apex moderately produced. Apical segment slightly emarginate at apex. *Legs:* Profemur with carinate tubercle on inner surface near basal 0.20; prominent spine on inner surface at apical 0.33. Metafemur broad; lateral surface markedly arcuate; median surface sinuate. Metatibia slightly expanded with prominent brush of hairs at apical 0.33; basal 0.50 arcuate. *Genitalia:* Aedeagus as illustrated (Fig. 33D)(33 examined).

Natural History. – Apart from the notation "stream banks", nothing is known concerning the habitat of this species.

Distribution. – (Figs. 34B,166). Known only from Cochise County in Arizona and Dona Ana County in New Mexico.

Etymology. – Latin, *bi* (two) plus *tuberculum* (small swelling). Named in reference to the two metasternal tubercles.

23. *Hydraena scintilla* new species
(Figs. 34B,36B,D,166)

Type-locality. – One mile N. Ixtlan de Juarez, Oaxaca, Mexico.

Type-specimens. – The holotype male and allotype with same data are deposited in USNM. These specimens were collected by my wife and I, July 5, 1974. One male paratype (PDP) has the following data: Intermittent desert stream, 2 miles N. Zimapan, Hidalgo, Mexico, May 21, 1974, M.E. and P.D. Perkins. One paratype of each sex (CAS) has the following data: Mexico, San Luis Potosi, Ciudad del Maiz, 9-I-1971, J.T. Polhemus.

Diagnosis. – Large size (1.92-2.02 mm), males with an excavation at the apex of the protibiae and a cariniform prominence on the inner surface of the profemora, plus aedeagal form (Figs. 36B,D), serve to distinguish this species from others whose adults also possess a brush of hairs on the metatibiae (males) and a well developed scintilla (both sexes).

Description. – *Form:* Elongate. *Size:* Holotype 1.92 mm long, 0.82 mm wide. *Color:* Dorsal surface dark brown; labrum dark brown; maxillary palpi brown except apices dark brown; antennae testaceous. Ventral surface dark brown except legs, elytral eipipleura and inflexed margin of pronotum brown. *Head:* Length 0.24 mm. Width 0.44 mm. Frons coarsely punctured, interstices approximately 0.50 puncture diameter, or less; surface shining; posterior margin emarginate to receive scintilla. Frontoclypeal suture straight. Clypeus microreticulate laterally, shining in midline. Labroclypeal suture nearly straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.32/0.16/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 arcuate in basal 0.17, straight in remainder, median surface sinuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface moderately shining, finely punctulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge very slightly developed. Postgena with punctation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly greater than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.48 mm; maximum width (at approximately midlength) 0.62 mm. sides margined, denticulate; sides moderately produced at middle, slightly arcuate and convergent to anterior angle, very slightly sinuate and moderately convergent to posterior; anterior border 0.48 mm wide, straight and nearly perpendicular to midline in lateral 0.25, slightly arcuate to rear in middle 0.50; posterior border 0.54 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola similar to those on disc. Posteroexternal foveola well developed. Interfoveolar depression well defined, discal area elevated. Area between external foveolae well elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola slightly developed, with punctures separated by thin walls. Disc moderately shining, punctures relatively large and deeply impressed, separated by thin walls; punctures with distinctive setae extended above cuticle in dry specimens. Scintilla distinct, flat, impunctate shelf with arcuate hind margin. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel, apex blunt, width at apex nearly 0.66 distance between internal and median carinae. Metasternum with plaques weakly developed, of small ovals at posterior 0.20 of metasternum. *Elytra:* Length 1.28 mm. Maximum width (at midlength) 0.82 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.50 puncture diameter, interstices between adjacent punctures of row generally narrower; punctures each with seta. Explanate margin quite narrow, with extremely fine, well separated serrations near anterior angles and apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin arcuate. Glabrous segments at apex moderately produced. Apical segment slightly emarginate at apex. *Legs:* Profemur with cariniform tubercle on inner surface near basal 0.33. Protibia excavate on inner surface at apex; prominent spine on inner surface at apical 0.33. Metafemur broad, lateral surface markedly arcuate, median surface sinuate. Metatibia gradually enlarged from base to apex; arcuate in basal 0.50; with prominent brush of hairs near apical 0.33. *Genitalia:* Aedeagus as illustrated (Figs. 36B,D)(3 examined).

Variation. – The aedeagus of the male from Hidalgo differs slightly from that of the holotype (Fig. 36D).

Natural History. – Specimens from the type-locality were removed from leaves which had become trapped behind water-soaked branches in a moderately large stream (Fig. 195B). Also taken from the leaves were specimens of *H. cuspidicollis*. The single male from Hidalgo was collected from sand and gravel at the margin of a very small, intermittent desert stream; *Ochthebius obscurus* adults were also taken at this locality.

Distribution. – (Figs. 34B,166). Known from the states of San Luis Potosi,Hidalgo and Oaxaca, Mexico.

Etymology. – Latin, *scintilla* (spark). Named in reference to the well developed pronotal scintilla.

24. *Hydraena canticacollis* new species
(Figs. 36C,166)

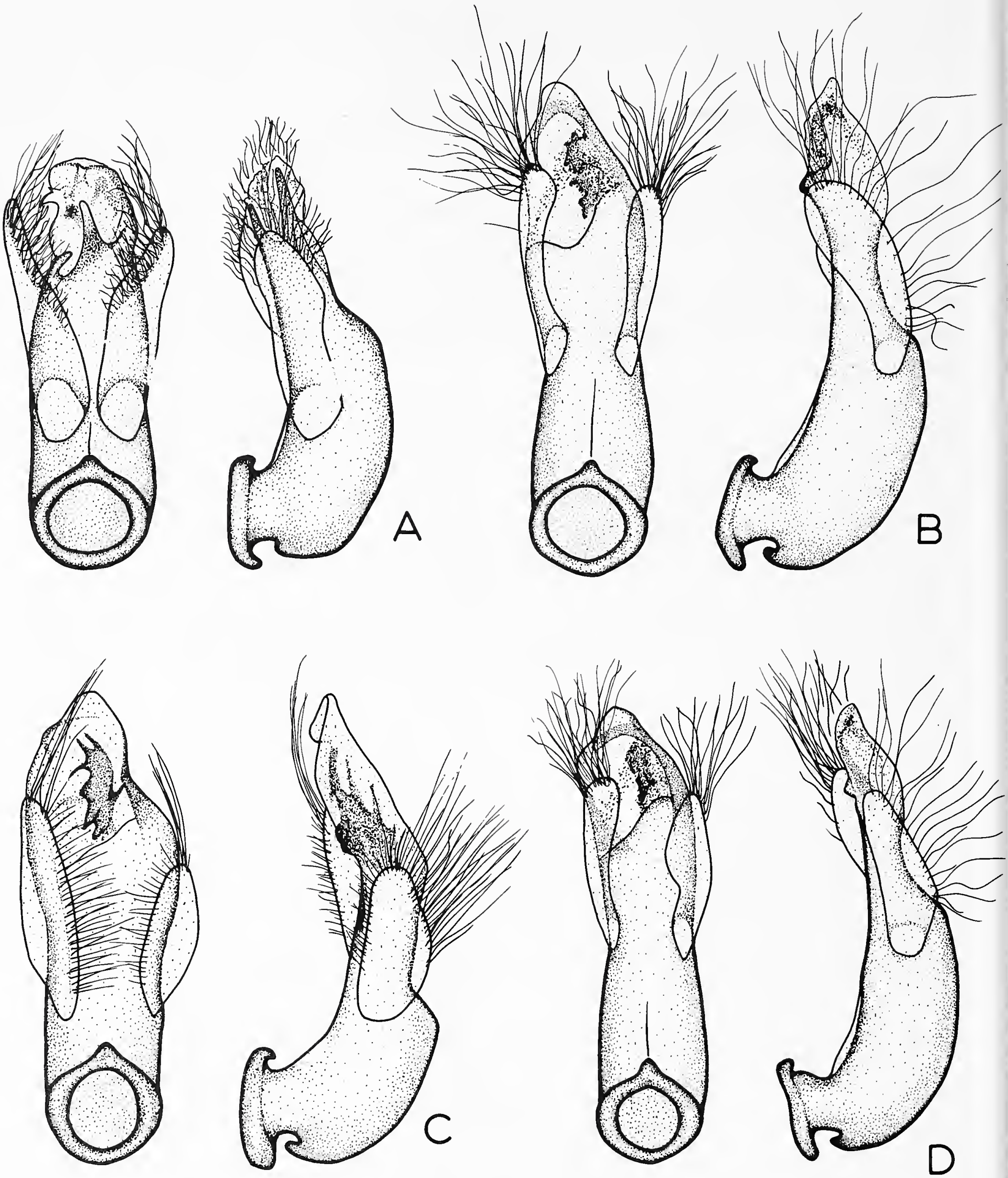
Type-locality. – Thirteen miles S. Jalpa, Zacatecas, Mexico.

Type-specimen. – The holotype male (unique) is deposited in USNM. My wife and I collected this specimen, July 16, 1974.

Diagnosis. – Readily distinguished by form of the metasternal plaques which are short but very markedly carinate. Each plaque is very sharp, nearly as high as long, and has the anterior extreme gradually tapered to the level of the remainder of the metasternum while the posterior extreme is extended abruptly above the surrounding area. The pronotum is also distinctive by virtue of its coarse, widely spaced punctures on the disc; some punctures are separated by twice their diameters.

Description. – *Form:* Elongate. *Size:* Holotype 1.76 mm long, 0.76 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi testaceous except apices brown; antennae testaceous. Pronotum dark brown except anterior and posterior borders, slightly lighter. Elytra brown. Ventral surface dark brown except legs, elytral epipeura and inflexed margin of pronotum brown. *Head:* Length 0.24 mm. Width 0.42 mm. Frons coarsely punctured, interstices less than puncture diameter; surface moderately shining; posterior margin emarginate in midline to receive scintilla. Frontoclypeal suture straight. Clypeus microreticulate in lateral areas, shining in midline. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed; surface punctulate; each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.32/0.16/0.22; palpomere 2 bent outward at approximately midlength; apex of palpomere 3 relatively expanded; palpomere 4 with lateral surface arcuate in basal 0.17, straight in remainder, median surface sinuate; apical segment widest slightly past midlength. Mentum wider than long, surface moderately shining, finely punctulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge nearly imperceptible. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (at approximately midlength) 0.60 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and moderately convergent to anterior angles, very slightly sinuate and moderately convergent to posterior; anterior border 0.48 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.52 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola closer together than those on disc. Posteroexternal foveola well developed. Interfoveolar depression well defined, discal area elevated. Area between external foveolae moderately elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola slightly developed, punctures somewhat closer together than punctures on disc. Disc moderately shining, punctures relatively large and deeply impressed, separated by 0.33 puncture diameter near anterior and posterior borders, punctures in middle, very unevenly spaced, some interstices thin walls, other equal to twice puncture diameter; punctures without distinctive setae extended above cuticle in dry specimens. Scintilla distinct, flat, impunctate shelf with arcuate hind margin. Prosternum carinate, carina produced anteriorly into a very short spine; coxae separted by thin median carina; carina a sinuate line when viewed laterally. Mesosternum with internal and external carinae diverging from anterior to posterior; median continuing to base of intercoxal process; intercoxal process relatively narrow, wider at apex than at base, apex blunt, width at base 0.33 distance between internal and median carinae. Metasternum with plaques small, carinate, moderately well elevated, posterior margin truncate. *Elytra:* Length 1.14 mm. Maximum width (at midlength) 0.76 mm. Surface moderately shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; punctures round; intervals not elevated, width approximately 0.50 puncture diameter, interstices between adjacent punctures of row approximately 0.25 puncture diameter; punctures each with seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine, well separated serrations along entire margin; serrations somewhat closer near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin extended obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin arcuate. Glabrous segments at apex well produced. Apical segment slightly emarginate at apex. *Legs:* Profemur with small tubercle on inner surface near basal 0.33. Protibia excavate on inner surface at apex. Metafemur broad, lateral surface strongly arcuate, median surface sinuate. Metatibia gradually enlarged from base to apex; arcuate in basal 0.50; with prominent brush of hairs at apical 0.33. *Genitalia:* Aedeagus as illustrated (Fig. 36C)(1 examined).

Natural History. – This specimen was collected from loose sand at the margin of a stream outwash area (Fig. 189C). The stream was flowing through a desert habitat. The microhabitat also contained adults of *Limnebius sinuatus.*



Figs. 36A – D, Aedeagi of *Hydraena* species. (A) *H. scopula*, holotype. (B) *H. scintilla*, holotype. (C) *H. canticacollis*, holotype. (D) *H. scintilla*, variant from Hidalgo, Mexico.

Distribution. – (Fig. 166). Known only from type-locality near Jalpa in Zacatecas, Mexico.

Etymology. – Latin, *cantica* (musical) plus *collis* (neck). This name refers to the scintilla of the pronotum and its supposed stridulatory function. It is also an attempt at onomatopoeia.

25. *Hydraena scopula* new species
(Figs. 34A,36A,166)

Type-locality. – Seven miles S. Mazamitla, Jalisco, Mexico.

Type-specimens. – The holotype male and allotype with same data are deposited in USNM. My wife and I collected these specimens July 15, 1974; two male paratypes (PDP) were also taken at that time. Other paratypes include specimens collected by Hugh B. Leech (CAS): type-locality, December 1, 1948 (2 females); 20 miles W. Jiquilpan, November 30, 1948 (1 male).

Diagnosis. – Among those species whose males have a well developed scintilla and a metatibial brush of hairs, *H. scopula* is very similar, externally, to *H. leechi*. The only reliable way to differentiate specimens of these two species is by characters of the male genitala (Fig. 36A).

Description. – *Form:* Elongate. *Size:* Holotype 1.76 mm long, 0.74 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi brown; antennae brown. Pronotum with disc dark brown, lateral areas lighter. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.24 mm. Width 0.42 mm. Frons coarsely punctured, interstices less than puncture diameter; interstices shining; posterior margin emarginate in midline to receive scintilla. Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture nearly straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.28/0.14/0.18; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface slightly arcuate in basal 0.25, nearly straight in apical 0.75, median surface sinuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface moderately shining, finely punctulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge very slightly developed. Postgena with microreticulation on slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (at approximately midlength) 0.58 mm; sides margined, denticulate; sides moderately produced at middle, nearly straight and slightly convergent to anterior angle, very slightly concave and convergent to posterior; anterior border 0.48 mm wide, straight and nearly perpendicular to midline in lateral 0.20, moderately arcuate to rear in middle 0.60, posterior border 0.52 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola similar to those on disc. Posteroexternal foveola well developed. Interfoveolar depression well defined, discal area elevated. Area between external foveolae slightly elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across 0.25 width of anterior region of pronotum. Transverse foveola slightly developed, punctures separated by thin walls. Disc moderately shining, punctures relatively large and deeply impressed, separated by thin walls near anterior and posterior borders, and by 0.50 puncture diameter in middle; some punctures with distinctive seta extended above cuticle in dry specimens. Scintilla distinct, flat, impunctate shelf with arcuate anterior and posterior margins. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel, apex blunt, width at apex 0.33 distance between internal and median carinae. Metasternum with plaques weakly developed, of small ovals at posterior 0.20 of metasternum. *Elytra:* Length 1.10 mm. Maximum width (at midlength) 0.74 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.33 puncture diameter, interstices generally narrower; punctures each with perceptible seta. Explanate margin quite narrow, ending near posterior 0.17 with extremely fine, well separated serrations near anterior angles and apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin arcuate. Glabrous segments at apex moderately produced. Segment 7 without emargination at apex. *Legs:* Profemur with small tubercle on inner surface near basal 0.33. Protibia with prominent spine on inner surface at apical 0.33. Metafemur moderately broad, lateral surface arcuate, median surface sinuate. Metatibia gradually enlarged from base to apex; arcuate in basal 0.50; prominent brush of hairs on inner surface at apical 0.33. *Genitalia:* Aedeagus as illustrated (Fig. 36A)(4 examined).

Natural History. – The type-locality consists of a moderately fast, pine forest stream. The substratum at the margin of the stream contained a higher percentage of mud than is usually seen in hydraenid streams. Consocies included *H. mazamitla*, *H. cuspidicollis* and *H. crystallina*.

Distribution. – (Figs. 34A,166). Known only from the state of Jalisco, Mexico.

Etymology. – Latin, *scopula* (small broom). I refer to the brush of hairs present on the metatibiae of males.

The *alternata* Subgroup

This subgroup presently consists of a single unusual species, *H. alternata*, from the mountains of Durango, Mexico. The elytra are broadly explanate and have alternate intervals elevated slightly. The latter feature is unique among Western Hemisphere *Hydraena*. As in the *leechi* Subgroup, both sexes have a well developed scintilla, and the hind tibiae of males are arcuate. However, the brush of hairs found on the hind tibiae of *leechi* Subgroup adults is replaced by two stiff spines in *H. alternata* adults. Further, the hind femora of *H. alternata* males have a group of prominent, curved hairs on the inner surface; these hairs are not as well developed in members of the *leechi* Subgroup.

The aedeagus of *H. alternata* males (Fig. 37A) is of a different basic form than that of the *leechi* Subgroup, providing additional justification for placing it in a separate subgroup.

According to d'Orchymont (1936:18), Kuwert's (1888) subgenus *Taenhydraena* has elevated alternate elytral intervals also. The aedeagal illustration presented by d'Orchymont (1936:39) for the single species of this subgenus, *H. exarata* Kiesenwetter, differs greatly from that of *H. alternata*. Most likely the elytral charac eristics of these two species have been independently derived, and are of species-group significance only.

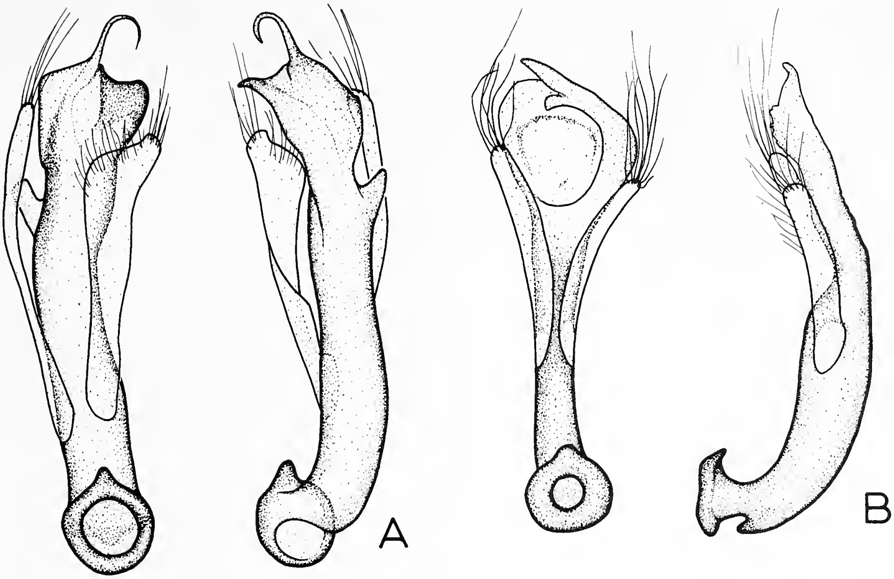
26. *Hydraena alternata* new species
(Figs. 34B,37A)

Type-locality. – Three miles E. La Ciudad, Durango, Mexico.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. Paul J. Spangler collected these specimens, July 1, 1964. Paratypes (27) are listed in the appendix.

Diagnosis. – Readily distinguished from all other Western Hemisphere *Hydraena* by the broadly explanate elytra which have elevated alternate intervals. The pronotum is coarsely punctate, each puncture with a short but distinctive seta; the interstices are very convex and shiny. Males have the metatibiae arcuate and with two spines on the inner surface near the distal 0.25; the metafemora are prominently pubescent on the inner surface.

Description. – *Form:* Elongate-oval. *Size:* Holotype 1.92 mm long, 0.84 mm wide. *Color:* Dorsal surface and labrum dark brown; maxillary palpi and antennae testaceous. Ventral surface dark brown except legs, elytral eipileura and inflexed margin of pronotum brown. *Head:* Length 0.24 mm. Width 0.44 mm. Frons coarsely punctured, some punctures nearly confluent; interstices shining; posterior margin slightly emarginate to receive scintilla. Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate and setose; each lobe symmetrical arc; median emargination ended above midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.32/0.14/0.22; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight, median surface evenly, extremely slightly arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface moderately shining, finely punctulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge weakly developed. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.17 interocular distance in width. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (at approximately midlength) 0.62 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.48 mm wide, straight and nearly perpendicular to midline in lateral 0.25,



Figs. 37A – B, Aedeagi of *Hydraena* holotypes. (A) *H. alternata*. (B) *H. campbelli*.

moderately arcuate to rear in middle 0.50, posterior border 0.52 mm wide, slightly arcuate to rear. Posterointernal foveolae well developed; punctures in foveola similar to those on disc. Posterointernal, anteroexternal foveolae and interfoveolar depression all confluent, in form of distinct, explanate surface. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola slightly developed, punctures separated by thin walls. Disc relatively dull, punctures large, deep and close set; interstices approximately 0.50 puncture diameter, rounded, on various levels, appearance somewhat rugulose, punctures each with seta extended above cuticle in dry specimens. Scintilla distinct, flat, impunctate shelf with arcuate hind margin. prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered, apex blunt, width at apex 0.33 distance between internal and median carinae. Metasternum with plaques moderately developed, triangular, median surfaces nearly parallel; 0.38 length of metasternum in midline; plaques flat in cross section. *Elytra:* Length 1.32 mm. Maximum width (at midlength) 0.84 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals 2, 4, 6, 8 and 10 (numbered from suture) markedly elevated; width of all intervals approximately equal to puncture diameter; adjacent punctures of row nearly contiguous; each puncture with seta. Explanate margin broad, extended to apices, with serrations along entire margin; serrations slightly closer near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated very slightly, obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly equilateral triangle, posterior margin arcuate. Glabrous segments at apex weakly produced. Segment 7 with emargination at apex. *Legs:* Protibia excavate on inner surface at apex. Metatibia arcuate, with two prominent spines on inner surface at apical 0.25. Metafemur prominently pubescent on inner surface. *Genitalia:* Aedeagus as illustrated (Fig. 37A)(14 examined).

Natural History. – Hans Reichardt collected this species in association with *Hydraena prieto* "ex under stones in a small creek in the mountains". I have collected it at the margin of a

stream flowing through a pine forest meadow in the mountains of Durango, Mexico. The margins of this stream were composed of rather hard-packed gravel; consocies included *Ochthebius madrensis* and *O. mexcavatus*.

Distribution. – (Fig. 34B). The mountains of Durango, Mexico.

Etymology. – Latin, *alternata* (alternating). This name refers to the elevated alternate intervals of the elytra.

The *scintillabella* Subgroup

Most members of this subgroup, like those of the *leechi* and *alternata* Subgroups, have a well developed scintilla. However, males have the metatibiae straight, without a brush of hairs or prominent spines. Males of the *leechi* Subgroup have the metatibiae markedly arcuate and with a brush of hairs (Fig. 32D), whereas those of the *alternata* Subgroup are likewise arcuate but have two prominent spines near the distal 0.25.

Adults of a few species of the *scintillabella* Subgroup, such as *H. terralta* and *H. alterra*, have the scintilla quite narrow, while in others, such as *H. colombiana* and *H. exilipes*, it is barely perceptible. In *H. ozarkensis* adults, the scintilla is apparent in males, barely perceptible in certain females, and imperceptible in other females. In *H. zapatina* adults a scintilla is not apparent, although the pronotum is very smooth in the appropriate location, in males.

Aedeagal affinities, which form morphoclines, help "tie" problem species characterized by absence of a scintilla, to their close relatives which have the scintilla more apparent. A discussion of this topic is developed in more detail in the section on phylogeny.

The *scintillabella* Subgroup, which currently consists of 17 species, ranges from the eastern United States (Ozark Plateau and Appalachian Mountains) south through Mexico to Paraguay.

27. *Hydraena scintillabella* new species
(Figs. 38B,167)

Type-locality. – 23 km. E. El Colegio, Cundinamarca, Colombia.

Type-specimen. – The holotype male (unique) is deposited in USNM. Paul and Phyllis Spangler collected this specimen, March 9, 1969.

Diagnosis. – The well developed scintilla, absence of plaques, plus the dark coloration and smooth, shiny dorsum combine to make adults of this attractive species very distinctive. The pronotal fascia and head are a deep, rich dark brown, contrasting attractively with the testaceous palpi. The reflected light passing through the scintilla produces an amber glow. The hydrofuge pubescence of the metasternum appears to be slightly longer in the region usually occupied by plaques.

Description. – *Form:* Elongate. *Size:* Holotype 1.64 mm long, 0.66 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum light brown at anterior and posterior 0.25, dark brown in center 0.50; sides slightly lighter than center. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.20 mm. Width 0.40 mm. Frons finely and sparsely punctured, many interstices five times puncture diameter; surface very shiny; posterior margin not emarginate. Frontoclypeal suture straight. Clypeus finely and sparsely punctulate, very shiny except at extreme sides. Labroclypeal suture slightly arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.28/0.12/0.22; palpomere 2 bent outward at approximately midlength; apices of

palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, arcuate in apical 0.66, median surface evenly, extremely slightly arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface shining, finely punctulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.17 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (at approximately midlength) 0.54 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and convergent to anterior angle, slightly sinuate and convergent to posterior; anterior border 0.44 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.48 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola similar to those on disc. Posteroexternal foveolae moderately developed. Interfoveolar depression slightly developed. Area between external foveolae weakly elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than on disc. Disc extremely shiny, punctures fine, separated by puncture diameter near anterior and posterior borders, and by two to three times puncture diameter in middle; punctures with seta extended above cuticle in dry specimens. Scintilla distinct, flat, impunctate shelf with arcuate hind margin. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad, sides parallel in apical 0.50, apex blunt, width at apex subequal distance separating internal and median carinae. Metasternum lacking plaques. Small, cariniform tubercle just lateral to normal location of plaques but on right side only, left side without tubercle. *Elytra:* Length 1.06 mm. Maximum width (at midlength) 0.66 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to puncture diameter, as are interstices between adjacent punctures of row; punctures each with seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine serrations near apices. Elytral apices, in dorsal aspect, slightly truncate; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly equilateral triangle; posterior margin straight. Glabrous segments at apex moderately produced, arched markedly to venter. Segment 7 emarginate at apex, and asymmetrical. *Legs:* Profemur with prominent cariniform tubercle on inner surface at base. Protibia arcuate, expanded in apical 0.33, with prominent group of setae at base of enlargement. Mesotibia flattened on inner surface in apical 0.33. Metatibia with lateral surface straight, medial surface slightly arcuate, widest near apical 0.33. *Genitalia:* Aedeagus as illustrated (Fig. 38B)(1 examined).

Distribution. – (Fig. 167). Known only from type-locality near El Colegio in Cundinamarca, Colombia.

Etymology. – Latin, *scintilla* (spark) plus *bella* (beautiful). This name refers to the attractiveness of adults and their pronotal scintilla.

Remarks. – The holotype has a small, cariniform prominence on the metasternum just lateral to the area usually occupied by plaques (but which are absent from adults of this species). This cariniform prominence is present on the right side only. No other Western Hemisphere *Hydraena* now known has such a metasternal modification.

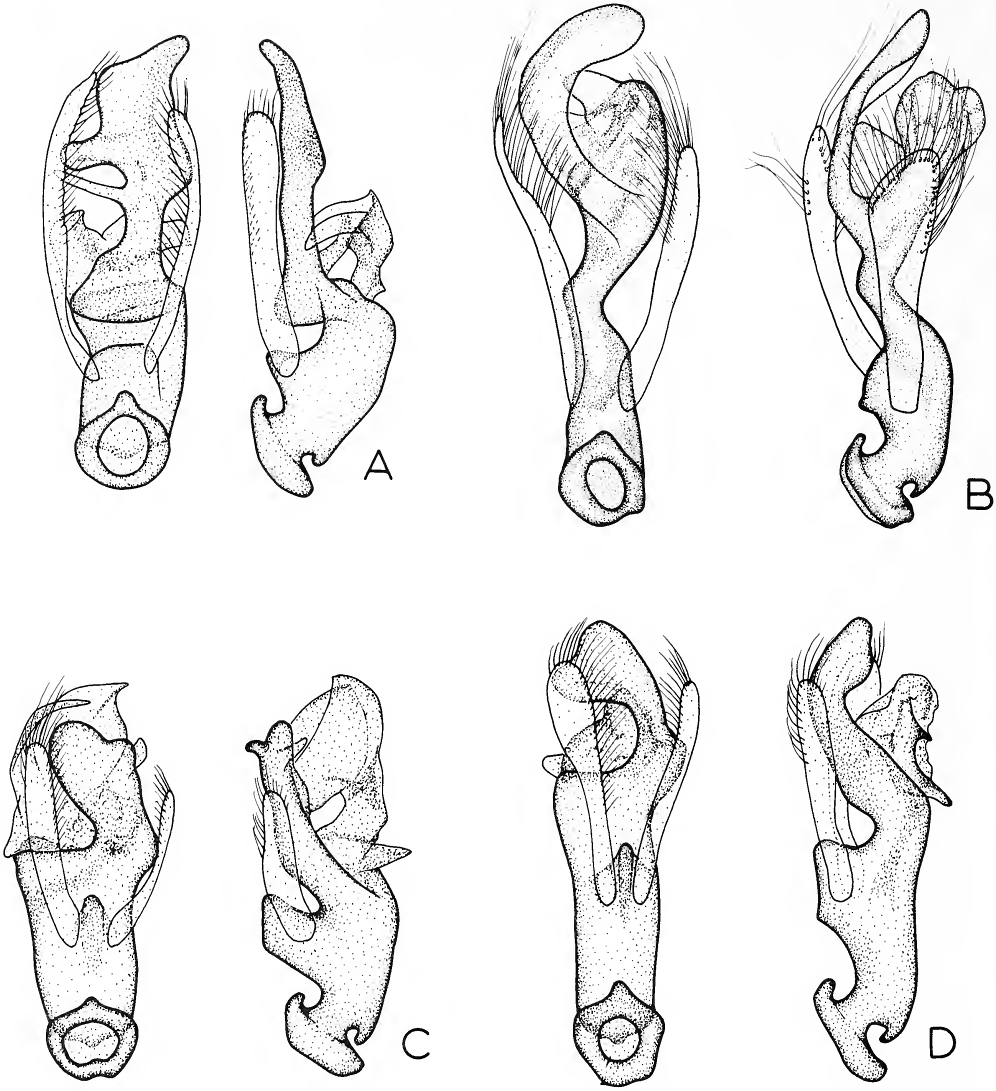
28. *Hydraena scintillutea* new species
(Figs. 38A,167)

Type-locality. – Jaboticatubas, km 117, Serra do Cipo, Minas Gerais, Brazil.

Type-specimens. – The holotype male is deposited in MSP. One male paratype, with same data, is deposited in USNM. These specimens were collected by Vanin and Froehlich, October 7, 1975.

Diagnosis. – Coarsely, densely punctate pronotum with a well demarcated, rectangular, dark brown macula on the disc which is nicely highlighted by the surrounding testaceous borders, plus a large scintilla serve to distinguish adults of *H. scintillutea.* The scintilla is very apparent not only because of its large size, but also because its shiny surface contrasts with the duller pronotum.

Description. – *Form:* Ovate. *Size:* Holotype 1.36 mm long, 0.58 mm wide. *Color:* Head black except maxillary palpi and antennae testaceous. Pronotum with rectangular dark brown macula on disc, remainder testaceous. Elytra



Figs. 38A – D, Aedeagi of *Hydraena* holotypes. (A) *H. scintillutea*. (B) *H. scintillabella*. (C) *H. alterra*. (D) *H. terralta*.

brown. Venter dark brown. Legs, inflexed margin of pronotum and elytral epipleura testaceous. *Head:* Length 0.22 mm; width 0.36 mm. Frons densely, closely punctate. Frontoclypeal suture slightly arcuate. Clypeus microreticulate, moderately punctate. Labroclypeal suture straight. Labrum microreticulate, bilobed, median emargination ended at midlength. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4 respectively: 0.20/0.09/0.16; palpomere 4 asymmetrical, widest near midlength. Mentum wider than long, dull, microreticulate. Submentum microreticulate. Genae shining, foveolate laterally; posterior ridge absent. Postgena microreticulate. *Thorax:* Pronotum length at midline 0.32 mm; maximum width (slightly behind midlength) 0.48 mm; sides margined, denticulate, moderately produced at middle, slightly arcuate and convergent to anterior angles, sinuate and convergent to posterior angles; anterior border 0.40 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.43 mm wide, slightly arcuate to rear. Posterointernal foveolae well developed, punctation similar to that on disc. Posteroexternal foveolae slightly developed. Interfoveolar depression moderately developed. Anteroexternal foveolae well developed, extended over slightly more than 0.25 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area closer together than those on disc. Disc dull, densely, moderately coarsely punctate, punctures apparently without setae. Scintilla large, posterior margin markedly arcuate. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin carina; carina sinuate in lateral view. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, apex blunt, width at apex 0.33 distance between internal and median carinae. Metasternum with plaques narrow, slightly elevated, microreticulate, slightly convergent anteriorly; plaques separated at base by three times plaque width; width of each plaque less than that of intercoxal process. *Elytra:* Length 0.88 mm; maximum width (slightly behind midlength) 0.58 mm. Disc moderately dull, with 10 rows of large punctures between suture and humeral callus, rows slightly irregular near suture in basal 0.25; intervals very narrow, zig-zag; interstices between punctures of row equally narrow. Explanate margin well developed, ended near posterior 0.14, edge extremely finely serrate. Elytral apices, in dorsal aspect, slightly truncate; in posterior aspect, elytral margin elevated obliquely toward suture, in form of slight angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle; posterior margin straight. Glabrous segments at apex markedly produced, arched ventrad; sternum 6 with oval depression in middle; tergum 7 not emarginate at apex. *Legs:* Profemur slightly excavate on inner surface in basal 0.50. Protibia slightly arcuate, inner surface expanded in apical 0.33. Other legs slender, unmodified. *Genitalia:* Aedeagus as illustrated (Fig. 38A)(2 examined).

Natural History. – The label notation, "riacho temporario" accompanies the specimens.

Distribution. – (Fig. 167). Presently known only from type-locality near Jaboticatubas in the state of Minas Gerais, Brazil.

Etymology. – Latin, *scintilla* (spark) plus *lutea* (yellow). This name refers both to the well developed scintilla and the distinctive testaceous borders of the pronotum which contrast attractively with the black macula.

29. *Hydraena alterra* new species
(Figs. 38C,167)

Type-locality. – Jaboticatubas, km 121, Serra do Cipo, Minas Gerais, Brazil.

Type-specimens. – The holotype male and allotype with identical data are deposited in MSP. Paratypes (2 males, 2 females) are deposited in MSP, USNM and PDP. These specimens were collected by Vanin and Froehlich, October 7, 1975.

Diagnosis. – Small size (1.28 mm long), dark color, absence of plaques, small scintilla, and rather coarsely punctate pronotum serve to distinguish *H. alterra* from other Brazilian members of the *leechi* group. The aedeagus should be studied to reliably distinguish males of this species from those of *H. terralta.*

Description. – *Form:* Ovate. *Size:* Holotype 1.28 mm long, 0.56 mm wide. *Color:* Dorsum of head and pronotal disc black, remainder brown. *Head:* Length 0.22 mm; width 0.34 mm. Frons closely, moderately coarsely punctate, pubescence rather apparent. Frontoclypeal suture slightly arcuate. Clypeus microreticulate. Labroclypeal suture straight. Labrum microreticulate, bilobed, median emargination ended at midlength. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4 respectively: 0.22/0.08/0.14; palpomere 4 slightly asymmetrical, widest near midlength. Mentum wider than long, microreticulate, punctulate. Submentum microreticulate. Genae shiny, foveolate laterally; posterior ridge absent, Postgena microreticulate. *Thorax:* Pronotum length at midline 0.30 mm; Maximum width (slightly behind midlength) 0.43 mm; sides margined, denticulate, moderately produced at middle, slightly arcuate and convergent to anterior angles, slightly sinuate and convergent to posterior angles; anterior border 0.36 mm wide, straight and nearly

perpendicular to midline in lateral 0.25, slightly arcuate to rear in middle 0.50; posterior border 0.40 mm wide, very slightly arcuate to rear. Posterointernal foveolae moderately developed, punctate as disc. Posteroexternal foveolae moderately developed. Interfoveolar depression moderately developed. Anteroexternal foveolae well developed, each extended across 0.25 width of anterior region of pronotum. Transverse foveola shallow, densely punctate, punctures closer together than those on disc. Disc dull, densely, moderately coarsely punctate, setae unapparent. Scintilla small, very narrow. Prosternum carinate, thin carina between coxae. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process narrow, apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum without plaques. *Elytra:* Length 0.68 mm; maximum width (slightly past midlength) 0.56 mm. Disc dull, with 10 rows of large, deep punctures between suture and humeral callus; intervals narrow, zig-zag; interstices between punctures of row equally narrow. Explanate margin well developed, ended near posterior 0.14, finely serrate. Elytral apices rounded in dorsal view; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle, posterior border straight. Glabrous segments at apex moderately produced. *Legs:* Protibia very slightly excavate, widest near distal 0.20, not expanded. Other legs slender, unmodified. *Genitalia:* Aedeagus as illustrated (Fig. 38C).(3 examined).

Natural History. – The label notation, "EM Leiothrix" accompanies the specimens.

Distribution. – (Fig. 167). Presently known only from the type-locality near Jaboticatubas in the highlands of Minas Gerais, Brazil.

Etymology. – Latin, *alta* (high) plus *terra* (land). I refer to the highlands of Brazil, the habitat of this species. The name *alterra* is also meant to symbolize the close relationship to *H. terralta*, and the shorter word, *alterra*, serves as a reminder that adults of this species are shorter in body length and aedeagal length than are those of *terralta*.

30. *Hydraena terralta* new species
(Figs. 38D,167)

Type-locality. – Jaboticatubas, km 121, Serra do Cipo, Minas Gerais, Brazil.

Type-specimen. – The holotype male (unique) is deposited in MSP. This specimen was collected by Vanin and Froehlich, October 7, 1975.

Diagnosis. – The aedeagus should be studied to reliably distinguish members of this species from those of *H. alterra*. *H. alterra* lacks plaques whereas the one specimen of *H. terralta* now known has very small, oval plaques. The very small size of the plaques, however, suggests that this feature may prove unreliable for identification purposes.

Description. – *Form:* Ovate. *Size:* Holotype 1.36 mm long, 0.58 mm wide. *Color:* Dorsum of head and pronotal disc black, remainder brown. *Head:* Length 0.22 mm; width 0.34 mm. Frons closely, moderately coarsely punctate. Frontoclypeal suture slightly arcuate. Clypeus microreticulate. Labroclypeal suture straight. Labrum microreticulate, bilobed, median emargination ended at midlength. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4 respectively: 0.20/0.08/0.14; palpomere 4 slightly asymmetrical, widest near midlength. Mentum wider than long, microreticulate, punctulate. Submentum microreticulate. Genae shiny, foveolate laterally; posterior ridge absent. Postgena microreticulate. *Thorax:* Pronotum length at midline 0.32 mm; maximum width (at midlength) 0.45 mm; sides margined, denticulate, moderately produced at middle, slightly arcuate and convergent to anterior angles, slightly sinuate and convergent to posterior angles; anterior border 0.36 mm wide, straight and nearly perpendicular to midline in lateral 0.25, slightly arcuate to rear in middle 0.50; posterior border 0.40 mm wide, very slightly arcuate to rear. Posterointernal foveolae moderately developed, punctate as disc. Posteroexternal foveolae moderately developed. Interfoveolar depression moderately developed. Anteroexternal foveolae well developed, each occupying about 0.25 width of anterior region of pronotum. Transverse foveola shallow, densely punctate, punctures closer together than those on disc. Disc dull, densely, moderately coarsely punctate, setae unapparent. Scintilla small, very narrow. Prosternum carinate, thin carina between coxae. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process, intercoxal process narrow, apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with plaques very small, nearly indistinguishable ovals near hind margin. *Elytra:* Length 0.88 mm; maximum width (near midlength) 0.58 mm. Disc dull, with 10 rows of large, deep punctures between suture and humeral callus; intervals narrow, zig-zag; interstices between punctures of row equally narrow. Explanate margin well developed, ended near posterior 0.14, finely serrate. Elytral apices rounded in dorsal view; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle, posterior border straight. Glabrous segments at apex moderately produced. *Legs:* Profemur with very small

tubercle on inner surface near midlength. Protibia slightly excavate on inner surface in distal 0.25. Other legs slender, unmodified. *Genitalia:* Aedeagus as illustrated (Fig. 38D)(1 examined).

Natural History. – The label notation, "EM *Leiothrix*" accompanies the specimen.

Distribution. – (Fig. 167). Presently known only from the type-locality near Jaboticatubas in the highlands of Minas Gerais, Brazil.

Etymology. – Latin, *terra* (land) plus *alta* (high). I refer to the highlands of Brazil, where this species is found. The name *terralta* is also meant to symbolize the close relationship to *H. alterra*, the putative sister-species. Additionally, since *terralta* is a longer word than *alterra*, it serves as a reminder that adults of this species are longer in aedeagal and body length than are those of *H. alterra*.

31. *Hydraena pavicula* new species
(Figs. 39A,167)

Type-locality. – Above Huinco, 8400 feet, Lima, Peru.

Type-specimen. – The holotype male (unique) is deposited in USNM. Harley P. Brown collected this specimen, November 12, 1971.

Diagnosis. – Distinguished from other members of the *leechi* Group which have a well developed scintilla by the markedly microreticulate lateral depressed areas of the pronotum and the microreticulation in and surrounding the elytral punctures. Adults are uniformly dark brown, nearly black on the dorsal surface, the legs and palpi being slightly lighter. The plaques are small, indistinctive ovals at the posterior 0.20 of the metasternum. Males have the protibiae expanded in the distal 0.50; the metatibiae are very slender, their greatest width being less than that of the protibiae.

Description. – *Form:* Elongate. *Size:* Holotype 1.80 mm long, 0.76 mm wide. *Color:* Dorsal surface dark brown. Maxillary palpi and antennae testaceous. Ventral surface dark brown except legs, elytral epipleurae and inflexed margin of pronotum brown. *Head:* Length 0.24 mm. Width 0.42 mm. Frons microreticulate, punctation coarse, punctures separated by 0.50 puncture diameter, or less; surface moderately dull. Frontoclypeal suture weakly arcuate to rear. Clypeus finely microreticulate at sides, very shiny in middle. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended slightly above midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.28/0.12/0.20; palpomere 2 bent outward at approximately midlength; palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, arcuate in apical 0.66, median surface arcuate; palpomere 4 widest near apical 0.33. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulation similar to mentum. Genae shining; lateral area of each gena with well developed foveola; posterior ridge slightly developed. Postgena with microreticulation similar to that of submentum. Last five antennomeres pubescent. Eyes 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.42 mm; maximum width (at approximately midlength) 0.56 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.44 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.52 mm wide, slightly arcuate to rear. Posterointernal foveolae well developed; punctures in foveola closer together than those on disc, some confluent. Anteroexternal and posteroexternal foveolae confluent, producing explanate sides of pronotum; microreticulation in this area well developed. Transversal foveola moderately developed, punctures closer together than punctures on disc. Disc moderately dull, microreticulate, punctures separated by one-two times puncture diameter, microreticulation extremely lightly impressed on interstices, reflections interrupted; each puncture with distinctive seta extended above cuticle in dry specimens. Scintilla distinct, flat, impunctate shelf with arcuate hind margin. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad, sides nearly parallel, apex blunt, width at apex 0.66 distance between internal and median carinae. Metasternum with low ridge posterior to intercoxal process; plaques small ovals at posterior 0.20. *Elytra:* Length 1.18 mm. Maximum width (at midlength) 0.76 mm. Surface dull, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures with irregular margins, microreticulate within punctures; surface uneven, reflections interrupted; intervals not elevated, width slightly greater than puncture diameter, interstices between adjacent punctures of row generally smaller; each puncture with seta. Explanate margin quite narrow, ended near posterior 0.20, with prominent

serrations near anterior angles. Elytral apices, in dorsal aspect gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex moderately produced. Segment 7 with deep, oblique meargination on left side near apex. *Legs:* Profemur with oblique carina on inner surface at base. Protibia enlarged on inner surface in apical 0.50. Metatibia gradually enlarged from base to apex. *Genitalia:* Aedeagus as illustrated (Fig. 39A)(1 examined).

Distribution. – (Fig. 167). Presently known only from the type-locality near Huinco in the department of Lima, Peru.

Etymology. – Latin, *pavicula* (rammer). Named in reference to the ram-like appearance of the aedeagus (lateral view).

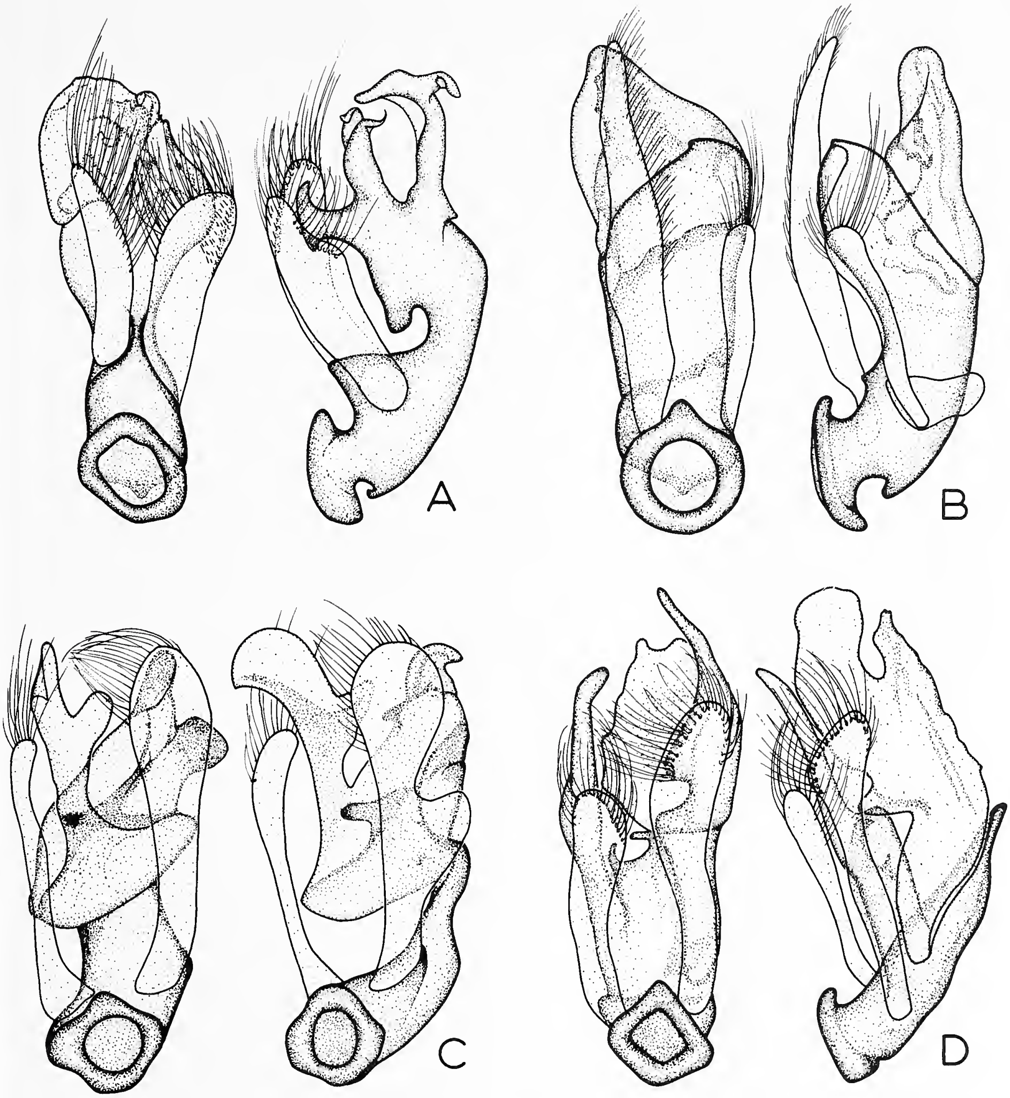
32. *Hydraena costiniceps* new species (Figs. 39B,167)

Type-locality. – Salta, Salta, Argentina.

Type-specimen. – The holotype male (unique) is deposited in USNM. Paul and Phyllis Spangler collected this specimen, May 18, 1969.

Diagnosis. – Males of *H. costiniceps* are distinguished from those of other species which have a pronotal scintilla by the unmodified legs, densely punctate pronotum, plaque shape and aedeagal form (Fig. 39B). The pronotum is densely punctate, most punctures separated by less than puncture diameter; the surface is relatively shiny, however, due to the very smooth, flat interstices. The plaques are triangular, the anterior ends being ill-defined, not well demarcated.

Description. – *Form:* Elongate. *Size:* Holotype 1.60 mm long, 0.72 mm wide. *Color:* Head with dorsal surface and labrum dark brown; maxillary palpi and antennae testaceous. Pronotum testaceous at anterior and posterior 0.25, dark brown in center 0.50; sides slightly lighter than center. Elytra brown approximately midway in color between extremes of pronotum. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.20 mm. Width 0.40 mm. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter; setae quite distinctive; surface shining; posterior margin emarginate in midline to receive scintilla. Surface posterior to emargination with transverse ridges. Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.30/0.12/0.22; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface slightly expanded at apical 0.33, median surface arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge nearly imperceptible. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (at approximately midlength) 0.54 mm; sides margined, denticulate; sides relatively weakly produced at middle, slightly arcuate and slightly convergent to anterior angle, very slightly sinuate and slightly convergent to posterior; anterior border 0.44 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.48 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola similar to those on disc. Posteroexternal foveola delimited by a very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression absent. Area between external foveolae weakly elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc shining, punctures close together and fine, separated by less than puncture diameter to thin walls; punctures each with distinctive seta extended above cuticle in dry specimens. Scintilla distinct, flat, impunctate shelf with arcuate anterior and posterior margins. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides parallel, apex blunt, width 0.66 distance between internal and median carinae. Metasternum with plaques moderately developed, triangular, median margins divergent moderately from posterior to anterior; plaques nearly 0.50 length of metasternum in midline; width of each plaque at posterior 0.66 width of intercoxal process; plaques flat in cross section. *Elytra:* Length 1.07 mm. Maximum width (at midlength) 0.72 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.66 puncture diameter, as are interstices between adjacent punctures of a row; punctures each with a seta.



Figs. 39A – D, Aedeagi of *Hydraena* holotypes. (A) *H. pavicula.* (B) *H. costiniceps.* (C) *H. zapatina.* (D) *H. colombiana.*

Explanate margin quite narrow, ended near posterior 0.10, with extremely fine serrations near apices. Elytral apices, in dorsal aspect, moderately truncate; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin arcuate. Glabrous segments at apex moderately produced. Apical segment semi-circular, slightly emarginate at apex. *Legs:* Without apparent modification. *Genitalia:* Aedeagus as illustrated (Fig. 39B)(1 examined).

Distribution. – (Fig. 167). Presently known only from the type-locality, Salta, Argentina.

Etymology. – Latin, *costa* (ridge) plus *ina* (diminutive) plus *ceps* (head). I refer to the very small ridges on the occipital region of the head, above which is the scintilla.

33. *Hydraena germaini* d'Orchymont
(Fig. 167)

Hydraena germaini d'Orchymont, 1923:38. (holotype depository uncertain; type-locality: Cochabamba, Bolivia).

According to d'Orchymont (1923) the holotype is deposited in the Museum National d'Histoire Naturelle, Paris. Through the courtesy of that institution I have received for study a single female paratype from the type-locality. There is a distinct possibility that further search may result in finding the holotype, consequently I am not designating a lectotype at this time.

Diagnosis. – Adults are very similar to those of *H. costiniceps*, differing primarily in less dense pronotal punctation. A more definitive diagnosis must await discovery of males and description of the aedeagus.

Description. – *Form:* Elongate. *Size:* Paratype female studied 1.64 mm long, 0.74 mm wide. *Color:* Head with dorsal surface dark brown except almost black areas near eyes; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum testaceous except transverse, rectangular, brown (lighter than head) macula on disc approximately 0.20 mm long, 0.38 mm wide; macula at borders blended into surrounding testaceous areas. Elytra brownish, intermediate in darkness between pronotal macula and pronotal lateral areas. Ventral surface dark brown except maxillae, legs, elytral epipleura and inflexed margin of pronotum light brown. *Head:* Length 0.23 mm. Width 0.41 mm. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter; surface shining. Frontoclypeal suture arcuate to rear. Clypeus microreticulate. Labroclypeal suture straight across middle when in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.29/0.11/0.21; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, arcuate in apical 0.66, median surface evenly, extremely slightly arcuate; palpomere 4 widest at distal 0.33. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (at approximately midlength) 0.56 mm; sides margined, denticulate; sides relatively weakly produced at middle, slightly arcuate and slightly convergent to posterior; anterior border 0.46 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.54 mm wide, slightly arcuate to rear. Posterointernal foveolae slightly developed; punctures in foveola slightly closer together than those on disc. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression absent. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc shining, punctures fine and deeply impressed, separated by one-two times puncture diameter; most punctures with distinctive seta extended above cuticle in dry specimens. Scintilla distinct, flat, impunctate shelf with arcuate hind margin. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel, apex blunt, width at apex 0.66 distance between internal and median carinae. Metasternum with plaques well developed, straight, parallel, tapered from posterior to anterior; plaques 0.50 length of metasternum in midline; greatest width of each plaque subequal to width of intercoxal process at its midlength; plaques separated posteriorly by twice plaque width; plaques separated anteriorly by approximately six times plaque width; plaques flat in cross section. *Elytra:* Length 1.06 mm. Maximum width (at midlength) 0.74 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.66 puncture diameter, interstices between adjacent punctures of row generally smaller; each puncture with seta. Explanate margin quite narrow, ended near posterior 0.20, with serrations near anterior angles and in posterior 0.33. Elytral apices, in dorsal aspect, truncate; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin arcuate. *Legs:* Protibia weakly arcuate in apical 0.50. *Genitalia:* Male unknown.

Distribution. – (Fig. 167). Presently known only from the type-locality, Cochabamba, Bolivia.

34. *Hydraena colombiana* new species
(Figs. 39D,167)

Type-locality. – 11 km. N. Bogotá, Cundinamarca, Colombia.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. Paratypes with same data are in USNM(2) and PDP(2). These specimens were collected by Paul and Phyllis Spangler, March 1-8, 1969.

Diagnosis. – Plaques are narrow, slightly arcuate, tapered to an acute apex anteriorly; basally they are separated by about four times the width of a plaque. Males have the pronotal scintilla slightly developed, the legs lacking modifications. The scintilla of females is extremely narrow, nearly imperceptible. The aedeagus (Fig. 39D) is very distinctive.

Description. – *Form:* Elongate. *Size:* The holotype is 1.60 mm long, 0.64 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi brown; antennae brown. Pronotum brown at anterior and posterior 0.25, dark brown in center 0.50. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.20 mm. Width 0.38 mm. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter; surface shining, posterior margin emarginate to receive scintilla. Frontoclypeal suture straight. Clypeus microreticulate at sides, sparsely in midline. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.26/0.10/0.20; palpomere 2 bent outward at approximately midlength; apices palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, arcuate in apical 0.66, median surface evenly, extremely slightly arcuate; palpomere 4 widest near midlength. Mentum wider than long, surface moderately shining, finely microreticulate. Submentum microreticulate. Genae moderately shining; lateral area of each gena with well developed foveola; posterior ridge nearly imperceptible. Postgena with punctation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.38 mm; maximum width (at approximately midlength) 0.52 mm; sides margined, denticulate; sides relatively slightly produced at middle, slightly arcuate and slightly convergent to anterior angle, very slightly sinuate and slightly convergent to posterior; anterior border 0.42 mm wide, straight and nearly perpendicular to midline in lateral 0.25; moderately arcuate to rear in middle 0.50; posterior border 0.48 mm wide, slightly arcuate to rear. Posterointernal foveolae weakly developed; punctures in foveola somewhat closer together than those on disc. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression shallow and broad. Area between foveolae not elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc shining, punctures fine, separated by 0.50 puncture diameter near anterior and posterior borders by puncture diameter in middle; punctures each with distinctive seta extended above cuticle in dry specimens. Scintilla distinct, flat, impunctate shelf with arcuate hind margin. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel, apex rounded, width slightly less than 0.50 distance between internal and median carinae. Metasternum with plaques well developed, slightly arcuate, triangular, converging strongly from posterior to anterior; plaques 0.50 length of metasternum in midline; greatest width of each plaque subequal to width of intercoxal process at its midlength; plaques separated posteriorly by approximately four times greatest width of a plaque; plaques separated anteriorly by twice plaque width; plaques flat in cross section. *Elytra:* Length 1.06mm. Maximum width (at midlength) 0.64 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, some rows quite irregular, some punctures random at most anterior, most punctures round; intervals not elevated, width approximately equal to puncture diameter, as are interstices between adjacent punctures of a row; punctures each with a seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine serrations near apices. Elytral apices, in dorsal aspect, slightly truncate; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex moderately produced. Segment 7 emarginate at apex. *Legs:* Without apparent modification. *Genitalia:* Aedeagus as illustrated (Fig. 39D)(3 examined).

Distribution. – (Fig. 167). Presently known only from the type-locality near Bogotá, Colombia.

Etymology. – Latin, *colombiana*, in reference to the geographical distribution.

35. *Hydraena paraguayensis* Janssens (Fig. 167)

Hydraena paraguayensis Janssens, 1972:259 (lectotype female deposited in ISNB, here designated; type-locality: Acaray waterfall, Puerto Presidente Stroessner, Alto Paraná, Paraguay).

Diagnosis. – Among the South American species of the *leechi* group whose adults possess a pronotal scintilla, *H. paraguayensis* adults are distinguished by the prosternum, which has a small shelf between the procoxae and the median carina. Males are not yet known for this species.

Description. – *Form:* Elongate-oval. *Size:* Lectotype 1.40 mm long, 0.62 mm wide. *Color:* Head with dorsal surface dark brown; labrum brown; maxillary palpi and antennae testaceous. Pronotum light brown except macula extended as transverse band from side to side from anterior 0.42 to posterior 0.14, macula lighter at margins. Elytra midway in color between lighter and darker areas of pronotum. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum, brown. *Head:* Length 0.24 mm. Width 0.36 mm. Frons moderately punctured, interstices equal to or slightly less than puncture diameter; surface moderately shining. Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture slightly arcuate when in dorsal aspect. Labrum bilobed, microreticulate, each lobe asymmetrical arc; median emargination ended slightly above midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.24/0.08/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, arcuate in apical 0.66, median surface arcuate; apical segment widest near distal 0.33. Mentum nearly quadrangular, surface shining, finely and sparsely punctulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes 0.16 interocular distance in width. *Thorax:* Pronotum length at midline 0.32 mm; maximum width (at approximately midlength) 0.48 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.40 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.44 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola similar to those on disc. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression very slightly developed. Area between external foveolae not elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc shining, punctures fine, separated by puncture diameter near anterior and posterior borders, and by twice puncture diameter in middle; most punctures with seta extended above cuticle in dry specimens. Scintilla distinct, flat, impunctate shelf with arcuate hind margin. Prosternum carinate, carina produced anteriorly into short spine; coxae separated from median carina by thin shelf; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad, sides nearly parallel, apex blunt, width at apex equal distance between internal and median carinae. Metasternum with plaques moderately developed, straight, convergent moderately from posterior to anterior; each plaque subtriangular, widest at base; plaques 0.43 length of metasternum in midline; greatest width of each plaque 0.33 width of intercoxal process at its midlength; plaques separated posteriorly by approximately three times plaque width; plaques flat in cross section. *Elytra:* length 0.88 mm. Maximum width (at midlength) 0.62 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to puncture diameter, as are interstices between adjacent punctures of row; each puncture without seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine, well separated serrations along entire margin; serrations somewhat closer near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. *Legs:* Protibia very slightly arcuate; other legs without apparent modification. *Genitalia:* Males unknown.

Distribution. – (Fig. 167). Known only from the type-locality near Puerto Presidente Stroessner in the Department of Alto Parana, Paraguay.

Remarks. – The holotype and two paratypes of *H. paraguayensis* were requested from the Institut royal des Sciences Naturelles de Belgique (through E. Janssens). When the shipping box arrived, however, it was found to contain the pin with holotype label and locality labels, but the specimen was no longer glued to the card. A search of the box proved fruitless. Therefore, one of the paratypes was selected to serve as the lectotype, and is herein so designated.

36. *Hydraena plaumanni* d'Orchymont
(Fig. 167)

Hydraena plaumanni d'Orchymont, 1937:457. (holotype female in ISNB; type-locality: Nova Teutonia, Santa Catarina, Brazil).

Diagnosis. – Distinguished from other Brazilian members of the *leechi* Group which have a pronotal scintilla by form of the metasternal plaques, which are arcuate and separated posteriorly by three times the width of a plaque. Males are not yet known for this species.

Description. – *Form:* Elongate. *Size:* Holotype 1.44 mm long, 0.56 mm wide. *Color:* Head with dorsal surface and labrum dark brown; maxillary palpi and antennae testaceous. Pronotum testaceous except for transverse, rectangular, brown (lighter than head) macula on disc approximately 0.10 mm long, 0.30 mm wide; macula at anterior and posterior borders abruptly disappearing, at sides blended into surrounding testaceous areas. Elytra same color as pronotal macula. Ventral surface dark brown except maxillae, legs, plaques, elytral epipleura and inflexed margin of pronotum testaceous. *Head:* Length 0.20 mm. Width 0.35 mm. Frons coarsely punctured, interstices less than puncture diameter; surface dull. Frontoclypeal suture straight. Clypeus finely punctulate. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.26/0.08/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight, medial surface arcuate, widest slightly past midlength. Mentum wider than long, surface shining, punctures fine, sparse. Submentum microreticulate. Genae moderately shining, punctulate; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation similar to that of submentum. Last five antennomeres pubescent. Eyes 0.17 interocular distance in width. *Thorax:* Pronotum length at midline 0.34 mm; maximum width (at approximately midlength) 0.47 mm; sides margined, denticulate; sides relatively weakly produced at middle, slightly arcuate and slightly convergent to anterior angle, slightly sinuate and slightly convergent to posterior; anterior border 0.39 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.42 mm wide, slightly arcuate to rear. Posterointernal foveolae very slightly developed; punctures in foveola closer together than those on disc. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression absent. Area between external foveolae flat. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, although punctures in this area are somewhat closer together than punctures on disc. Disc moderately shining, punctures fine and deeply impressed, separated by narrow walls near anterior and posterior borders, and by 0.5-1.0 times puncture diameter in middle; most punctures with seta extended above cuticle in dry specimens. Scintilla distinct, flat, impunctate shelf with arcuate hind margin. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel, apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with plaques well developed, slightly arcuate, with concave side toward midline; 0.50 length of metasternum in midline; greatest width of each plaque subequal to width of intercoxal process at its midlength; plaques separated posteriorly by approximately twice plaque width; plaques separated anteriorly by basal width of a plaque; plaques flat in cross section. *Elytra:* Length 0.92 mm. Maximum width (at midlength) 0.60 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width 0.50 puncture diameter, as are interstices between adjacent punctures of row; each puncture with seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine, well separated serrations along entire margin; serrations somewhat closer near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex moderately produced. *Legs:* Without apparent modification. *Genitalia:* Males unknown.

Distribution. – (Fig. 167). Known only from the type-locality at Nova Teutonia in the state of Santa Catarina, Brazil.

Remarks. – The holotype is the only specimen I have studied.

37. *Hydraena sordida* Sharp
(Fig. 167)

Hydraena sordida Sharp, 1882:94 (lectotype female in BMNH, here designated; type-locality: San Joaquin, Baja Verapaz, Guatemala).

Diagnosis. – The finely, densely punctate pronotum with its well developed scintilla, plus shape of plaques, which are reduced to small ovals at the posterior 0.20 of the metasternum, must serve as the characteristics, albeit rather unsatisfactory, to distinguish *H. sordida* adults. A more complete diagnosis must await discovery of males.

Description. – *Form:* Elongate. *Size:* Lectotype 1.67 mm long, 0.74 mm wide. *Color:* Head with dorsal surface brown; labrum brown; maxillary palpi brown; antennae testaceous. Pronotum brown, lighter toward lateral areas. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.24 mm. Width 0.42 mm. Frons moderately punctured, most interstices less than puncture diameter; surface moderately shining. Frontoclypeal suture arcuate to rear. Clypeus microreticulate. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.28/0.11/0.19; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight, medial surface arcuate, widest near midlength. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulation similar to mentum. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.17 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (at approximately midlength) 0.57 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.46 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.46 mm wide, slightly arcuate to rear. Posterointernal foveolae well developed; punctures in foveola closer together than those on disc. Posteroexternal foveola well developed. Interfoveolar depression well developed, disc elevated. Area between external foveolae elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, occupying slightly less than 0.33 width of anterior region of pronotum. Transverse foveola slightly developed, punctures closer together than punctures on disc. Disc moderately dull, punctures fine, deeply impressed, separated by puncture diameter to nearly confluent; most punctures with seta extended above cuticle in dry specimens. Scintilla distinct, flat, impunctate shelf with arcuate hind margin. Prosternum carinate, carina produced anteriorly into very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect.Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad, sides nearly parallel; apex blunt, width at apex nearly 0.66 distance between internal and median carinae. Metasternum with plaques very small ovals at posterior 0.20. *Elytra:* Length 1.07 mm. Maximum width (at midlength) 0.74 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.50 puncture diameter, as are interstices between adjacent punctures of a row; each puncture with a seta. Explanate margin quite narrow, ended near posterior 0.14, with extremely fine, well separated serrations along entire margin; serrations slightly closer near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. *Legs:* Protibiae very slightly arcuate; other legs without apparent modification. *Genitalia:* Males unknown.

Distribution. – (Fig. 167). Baja Verapaz, Guatemala.

Remarks. – Other than the lectotype I have seen only four females, two from the type-locality, and two from San Geronimo. These four specimens are herein designated paralectotypes.

38. *Hydraena puncticollis* Sharp
(Fig. 167)

Hydraena puncticollis Sharp, 1882:93 (lectoype female in BMNH, here designated; type-locality: Paso Antonio, 400 feet, Guatemala).

Diagnosis. – Small size (1.46 mm long), coarse pronotal punctation, and elytral apices, which do not form an angle with one another in posterior aspect, serve as the diagnostic features available at this time. Males are unknown. Refer to the remarks section for futher comments.

Description. – *Form:* Elongate-oval. *Size:* Lectotype 1.46 mm long, 0.66 mm wide. *Color:* Head with dorsal surface and labrum dark brown; maxillary palpi and antennae brown. Pronotum dark brown except for transverse, rectangular, black macula on disc approximately 0.16 mm long, 0.34 mm wide; macula at borders blended into surrounding brownish areas. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin

of pronotum, brown. *Head:* Length 0.19 mm. Width 0.35 mm. Frons coarsely punctured, interstices less than puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture arcuate when viewed from above. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.26/0.10/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight; median surface evenly, extremely slightly arcuate; palpomere 4 widest slightly past midlength. Mentum longer than wide, surface moderately shining, finely punctulate. Submentum evenly, finely microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.35 mm; maximum width (at approximately midlength) 0.48 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and slightly convergent to anterior angle, arcuate and slightly convergent to posterior; anterior border 0.40 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.44 mm wide, slightly arcuate to rear. Posterointernal foveolae well developed; punctures in foveola similar to those on disc. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc shining, punctures fine, separated by puncture diameter; each puncture with seta extended above cuticle in dry specimens. Scintilla distinct, flat, impunctate shelf with arcuate hind margin. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel, apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with plaques well developed, slightly arcuate, convergent moderately from posterior to anterior; plaques separated posteriorly by approximately three times plaque width; plaques separated anteriorly by plaque width; plaques slightly rounded in cross section. *Elytra:* Length 0.92 mm. Maximum width (at midlength) 0.68 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to puncture diameter, as are interstices between adjacent punctures of a row; each puncture with a seta. Explanate margin quite narrow, ended near posterior 0.10, with extremely fine, well separated serrations along entire margin; serrations somewhat closer near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin does not elevate obliquely toward suture, not in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle, posterior margin straight. Glabrous segments at apex moderately produced. Segment 7 emarginate at apex. *Legs:* Protibia slightly concave on inner surface. Other legs without apparent modification. *Genitalia:* Males unknown.

Distribution. – (Fig. 167). Guatemala.

Remarks. – Among specimens I collected in the summer of 1974 are more than 200 *Hydraena* from various localities in Guatemala, Honduras and Mexico, some of which I believe may be conspecific with *H. puncticollis*. Although these specimens make up series from many localities and several different types of streams, all of the series include females only. Further study is necessary to determine whether absence of males is a sampling artifact or a result of parthenogenesis. These specimens appear to represent more than one species, based upon pronotal sculpture and body size, but without males I am unwilling to assign any of them to *H. puncticollis* or to describe them as new. A more precise diagnosis of *H. puncticollis* must await further material.

39. *Hydraena zapatina* new species
(Figs. 39C,167)

Type-locality. – Seven miles S. Mazamitla, Jalisco, Mexico.

Type-specimens. – The holotype male and allotype with identical data are deposited in USNM. My wife Maureen and I collected these specimens, August 15, 1974.

Diagnosis. – Combination of absence of a pronotal scintilla and random (non-serial) punctures on the elytral disc serve as diagnostic features for this species. The dorsal surface is very shiny, the pronotum being sparsely punctate and with a dark brown fascia which contrasts

well with the surrounding testaceous area. The plaques are well developed, convergent slightly anteriorly, separated at their bases by about plaque width; each plaque is about 0.50 the length of the metasternum and as wide as the mesosternal process. The metatibiae of males are expanded, but very slightly so, at midlength to form a small point, then tapered to the apex to form a slight indentation; within the indentation there are some stiff spines which contact the leg.

Description. – *Form:* Elongate. *Size:* Holotype 1.46 mm long, 0.62 mm wide. *Color:* Head with dorsal surface dark brown; labrum testaceous; maxillary palpi testaceous; antennae testaceous. Pronotum testaceous at anterior and posterior 0.25, dark brown in middle 0.50. Elytra brown. Ventral surface dark brown except legs, elytral epipleura, mentum and inflexed margin of pronotum testaceous. *Head:* Length 0.20 mm. Width 0.34 mm. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely microreticulate. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended slightly above midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.24/0.12/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface slightly arcuate, median surface evenly arcuate; palpomere 4 widest near midlength. Mentum wider than long, surface shining, finely punctulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.32 mm; maximum width (at approximately midlength) 0.44 mm; sides margined, denticulate; sides moderately produced at middle, slightly sinuate and convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.36 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.38 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola similar to those on disc. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression moderately developed. Area between external foveolae moderately elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc shining, punctures fine, separated by two to four times puncture diameter; each puncture with distinctive seta which extended cuticle in dry specimens. Scintilla absent, although this region very shiny. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad, sides nearly parallel, apex blunt, width at apex 0.66 distance between internal and median carinae. Metasternum with plaques well developed, straight, convergent moderately from posterior to anterior; plaques 0.50 length of metasternum in midline; width of each plaque subequal to width of intercoxal process; plaques separated posteriorly by slightly less than plaque width; plaques flat in cross section. *Elytra:* Length 0.88 mm. Maximum width (at midlength) 0.64 mm. Surface shining, disc with punctures somewhat serial near suture, randomly arranged on most of disc; most punctures separated by puncture diameter; punctures each with seta. Explanate margin quite narrow, ended near posterior 0.20. with extremely fine serrations near anterior angles. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, longer than wide, posterior margin straight. Glabrous segments at apex moderately produced. Segment 7 slightly emarginate at apex. *Legs:* Protibia slightly expanded on inner surface near midlength. Metatibiae gradually enlarged from base to midlength, then gradually tapered to apex, hence widest at midlength; posterior 0.50 with small stiff spines on inner surface in contact with leg. *Genitalia:* Aedeagus as illustrated (Fig. 39C)(1 examined).

Natural History. – Refer to *H. scopula.*

Distribution. – (Fig. 167). Presently known only from the type-locality near Mazamitla in the state of Jalisco, Mexico.

Etymology. – *zapatina*, from Spanish in reference to the shoe-shaped process of the aedeagus (lateral view).

40. *Hydraena campbelli* new species
(Figs. 37B,167)

Type-locality. – Junction of highways 190 and 195, Chiapas, Mexico.

Type-specimens. – The holotype male and allotype with identical data are deposited in CNC. J. M. Campbell collected these specimens, June 11, 1969. Paratypes from the same

locality are deposited in CNC (12), USNM (2) and PDP (2).

Diagnosis. – The only totally satisfactory characteristic to distinguish males of this species is aedeagal form (Fig. 37B), which is quite singular. *H. campbelli* adults are moderately small, about 1.45 mm long, with well developed scintilla in both sexes, and males lack a metatibial brush of hairs. The plaques are oval, occupy about the posterior 0.33 of the metasternum, and are very slightly convergent anteriorly.

Description. – *Form:* Elongate. *Size:* Holotype 1.44 mm long, 0.64 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum testaceous at anterior and posterior 0.25, dark brown in middle 0.50; sides lighter than middle, Elytra brown. Ventral surface dark brown except legs, elytral epipleura, mentum and inflexed margin of pronotum brown. *Head:* Length 0.20 mm. Width 0.38 mm. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter; surface moderately shining; posterior margin weakly emarginate to receive scintilla. Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture arcuate when viewed from above. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.26/0.10/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, arcuate in apical 0.66, median surface evenly, slightly arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface moderately shining, finely punctulate. Submentum microreticulate. Genae moderately shining; lateral area of each gena with well developed foveola; posterior ridge nearly imperceptible. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly greater than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (at approximately midlength) 0.52 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and slightly convergent to anterior angle, sinuate and moderately convergent to posterior; anterior border 0.42 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.44 mm wide, slightly arcuate to rear. Posterointernal foveolae very slightly developed; punctures in foveola somewhat closer together than those on disc. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression slightly developed. Area between external foveolae rather noticeably elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc moderately shining, punctures separated by thin walls near anterior and posterior borders, by 0.50 puncture diameter in middle; punctures without distinctive seta extended above cuticle in dry specimens. Scintilla distinct, flat, impunctate shelf with arcuate hind margin. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel, apex round, width nearly 0.50 distance between internal and median carinae. Metasternum with plaques moderately developed, somewhat oval, convergent moderately from posterior to anterior; plaques 0.33 length of metasternum in midline; greatest width of each plaque slightly less than width of intercoxal process at its midlength; plaques separated posteriorly by approximately twice plaque width; plaques flat in cross section. *Elytra:* Length 0.98 mm. Maximum width (at midlength) 0.64 mm. Surface moderately shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately 0.50 puncture diameter, as are interstices between adjacent punctures of a row; most punctures with a seta. Explanate margin quite narrow, ended near posterior 0.20, with fine serrations near anterior angles and apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle, posterior margin arcuate. Glabrous segments at apex moderately produced. Segment 7 without emargination at apex. *Legs:* Protibia slightly arcuate. Metatibia very slightly arcuate. *Genitalia:* Aedeagus as illustrate (Fig. 37B)(4 examined).

Distribution. – (Fig. 167). Known only from the type-locality in the mountains of Chiapas, Mexico.

Etymology. – I am pleased to dedicate this species to J. M. Campbell, who collected the only known specimens.

41. *Hydraena exilipes* new species
(Figs. 41D,167)

Type-locality. – Two miles SW Ciudad Victoria, Tamaulipas, Mexico.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. These specimens plus two male and three female paratypes (PDP) from the same locality were collected by my wife Maureen and I, July 27, 1974.

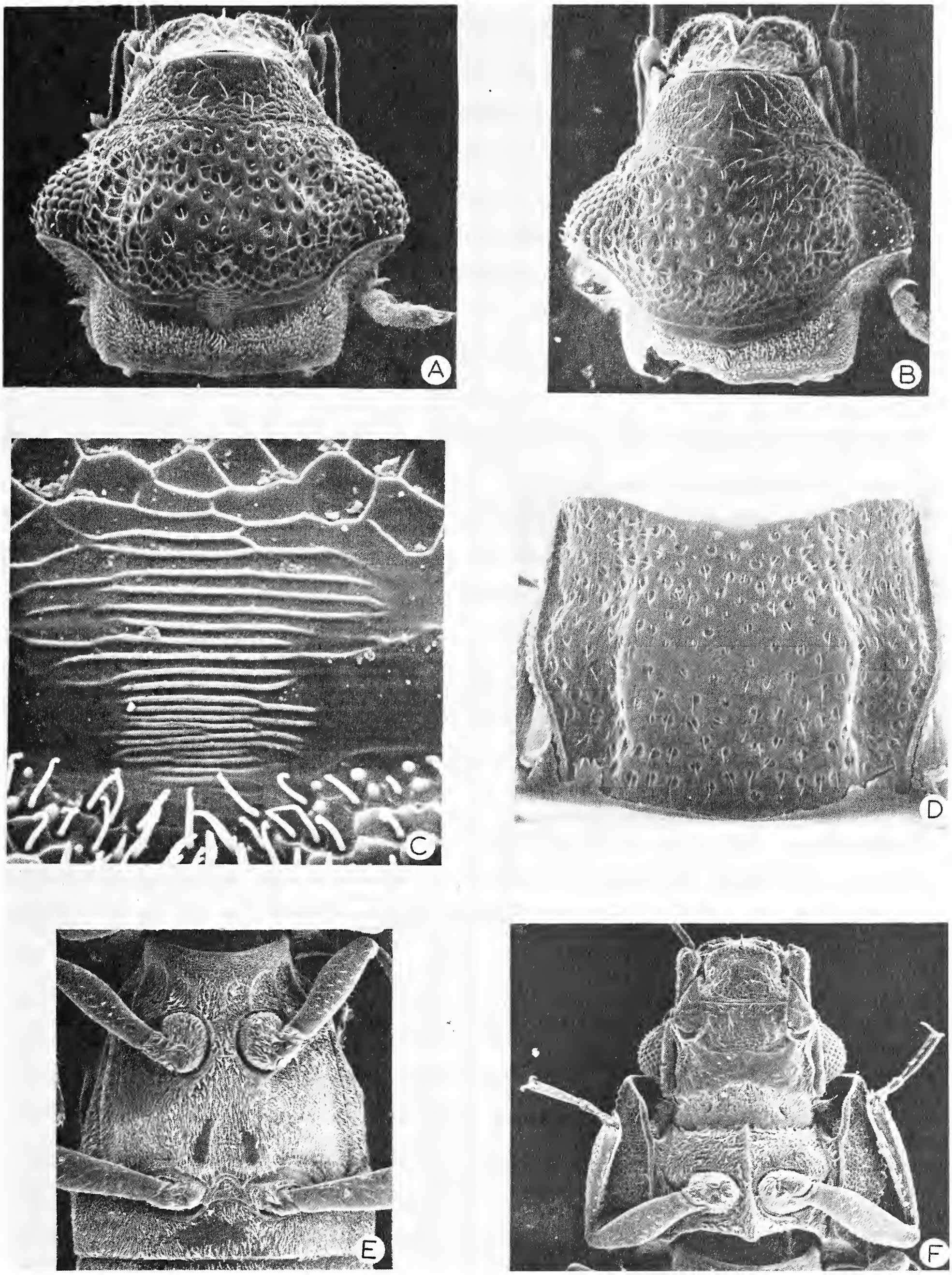
Diagnosis. – Distinguished from adults of other species of the *leechi* Group, which also lack a scintilla and do not have the anteromedian region of the metasternum elevated, by the small, oval plaques. The plaques are widely separated, the distance being about equal to four times the width of a plaque. The pronotum is distinctively produced at the sides, being nearly equally convergent to the anterior and posterior angles. The legs are exceptionally long and slender.

Description. – *Form:* Elongate. *Size:* Holotype 1.74 mm long, 0.74 mm wide. *Color:* Dorsal surface dark brown, except border of pronotum slightly lighter; maxillary palpi brown; antennae brown. Ventral surface dark brown except legs; elytral epipleura, mentum and inflexed margin of pronotum brown. *Head:* Length 0.24 mm. Width 0.40 mm. Frons moderately punctured, interstices equal to or slightly less than puncture diameter; setae quite prominent; surface dull. Clypeus microreticulate. Labroclypeal suture nearly straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.30/0.14/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight, median surface arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface dull, microreticulate. Submentum microreticulate. Genae moderately shining; lateral area of each gena with well developed foveola; posterior ridge moderately developed at sides, absent from midline. Postgena with microreticulation slightly smaller than that of submentum. Last five antennomeres pubescent. Eyes 0.50 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (at approximately midlength) 0.58 mm; sides margined, denticulate; sides rather markedly produced at middle, slightly arcuate and markedly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.42 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.48 mm wide, slightly arcuate to rear. Posterointernal foveolae well developed; punctures in foveola similar to those on disc. Posteroexternal foveola well developed. Interfoveolar depression slightly developed. Area between external foveolae slightly elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola slightly developed, with punctures separated by thin walls. Disc dull, punctures moderately large, generally separated by puncture diameter or less; each puncture with very distinctive seta extended above cuticle in dry specimens. Scintilla apparently absent; thin, much longer than wide, transparent shelf present in this region, but posterior margin indistinctly defined. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel, apex blunt, width at apex 0.66 distance between internal and median carinae. Metasternum with plaques weakly developed, oval in shape, approximately three times as long as wide, located at posterior 0.17, convergent moderately from posterior to anterior; plaques 0.17 length of metasternum in midline; plaques separated by about four times plaque width; plaques flat in cross section. *Elytra:* Length 1.14 mm. Maximum width (at midlength) 0.74 mm. Surface dull, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.50 puncture diameter, as are interstices between adjacent punctures of a row; each puncture with a distinctive seta. Explanate margin rather well developed, ended near apices, with serrations near anterior angles and apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin not elevated obliquely toward suture, not in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin weakly arcuate. Glabrous segments at apex moderately produced. Segment 7 somewhat conical; apex slightly emarginate. *Legs:* Profemur with tubercle on inner surface near basal 0.33. Protibia expanded on inner surface near apical 0.33, lateral surface straight. Metafemur relatively thin. Metatibia straight, gradually enlarged from base to apex, relatively long and thin. *Genitalia:* Aedeagus as illustrated (Fig. 41D)(3 examined).

Natural History. – These beetles were collected at the sand-gravel margin of a semi-arid stream. *Limnebius angustulus* adults were also found at this locality.

Distribution. – (Fig. 167). Presently known only from the type-locality near Ciudad Victoria in the state of Tamaulipas, Mexico.

Etymology. – Latin, *exilis* (thin) plus *ipes* (foot). This species has very slender legs.



Figs. 40A – F, *Hydraena ozarkensis*. (A) head of ♂, dorsal aspect. (B) head of ♀, dorsal aspect. (C) occipital ridges of ♂. (D) ♂ pronotum. (E) metasternum. (F) prosternum and venter of head.

42. *Hydraena ozarkensis* new species
(Figs. 40A-F,41A-B,42B,167)

Type-locality. – Rush Creek, 2 miles E. Jane, McDonald Co., Missouri.

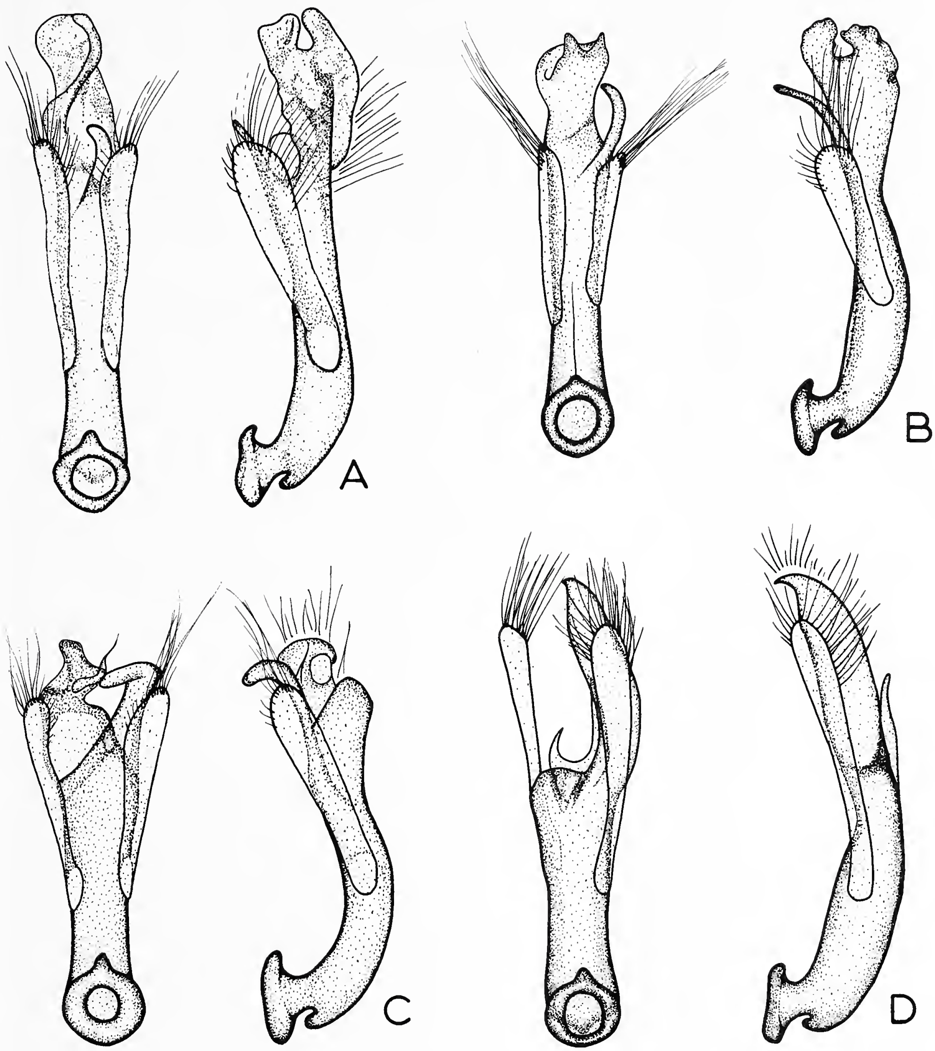
Type-specimens. – The holotype male and allotype with same locality data are deposited in USNM. I collected these specimens, August 8, 1972. Paratypes (61) are listed in the appendix.

Diagnosis. – Random, non-serial arrangement of punctures on the elytral disc plus small size, about 1.36 mm long, serve to readily distinguish *H. ozarkensis* adults from all other members of the *leechi* Group which have a pronotal scintilla, except *H. maureenae.* From this latter species *H. ozarkensis* is distinguished by broader form (with the sides of the elytra being rounded, not parallel), distribution (Fig. 42B), and aedeagus (Figs. 41A-C).

Description. – *Form:* Elongate-oval. *Size:* Holotype 1.36 mm long, 0.60 mm wide. *Color:* Head with dorsal surface dark brown, nearly black; labrum dark brown; maxillary palpi and antennae testaceous. Pronotum testaceous at anterior and posterior 0.33, reddish brown in center 0.33; elevated areas between external foveolae somewhat lighter than disc. Elytra brown. Ventral surface brown except legs, elytral epipleura, and inflexed margin of pronotum, light brown. *Head:* Length 0.20 mm. Width 0.36 mm. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter; surface shining; Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture nearly straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.24/0.12/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, arcuate in apical 0.66, median surface arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, microreticulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge nearly imperceptible. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly greater than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (at approximately midlength) 0.46 mm; sides margined, denticulate; sides moderately produced at middle, very slightly sinuate and slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.38 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.40 mm wide, slightly arcuate to rear.Posterointernal foveolae well developed; punctures in foveola closer together than those on disc. Posteroexternal well developed. Interfoveolar depression moderately developed. Area between external foveolae moderately elevated. Anteroexternal foveolae well developed, each foveola some what crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc shining, punctures well impressed, separated by puncture diameter; many punctures with seta extended above cuticle in dry specimens. Scintilla distinct, flat, impunctate shelf with arcuate hind margin. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated from median carina by thin shelf; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad, sides tapered, apex blunt, width at apex nearly 0.66 distance between internal and median carinae. Metasternum with plaques well developed, somewhat triangular, convergent moderately from posterior to anterior; plaques 0.40 length of metasternum in midline; greatest width of each plaque slightly less than width of intercoxal process at its apex; plaques separated posteriorly by approximately twice plaque width; plaques flat in cross section (Fig. 40E). *Elytra:* Length 0.88 mm. Maximum width (at midlength) 0.60 mm. Surface shining, disc with well impressed randomly arranged puncture; sutural and second row of punctures somewhat serial, other punctures randomly arranged; punctures rather well impressed; most punctures with seta. Explanate margin rather well developed, ended near posterior 0.10, with extremely fine serrations near anterior angles and apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin arcuate. Glabrous segments at apex moderately produced. Segment 7 without emargination at apex. *Legs:* Protibia very slightly excavate on inner surface in apical 0.33. Metatibia nearly parallel in apical 0.66. *Genitalia:* Aedeagus as illustrated (Figs. 41A-B) (20 examined).

Variation. – Males from Indiana have the apex of the aedeagus shaped slightly differently from that of the holotype. I have illustrated an example (Fig. 40B).

Natural History. – The stream at the type-locality is very small, the beetles being taken from the sand at the margin. Consocies included *Limnebius ozapalachicus* and *Paracymus* sp. H.S. Dybas has collected adults during their dispersal flight, between 4:45 and 5:15 pm, August 14, 1971.



Figs. 41A – D, Aedeagi of *Hydraena* species. (A) *H. ozarkensis*, holotype. (B) *H. ozarkensis*, variant from Monroe County, Indiana. (C) *H. maureenae*, holotype. (D) *H. exilipes*, holotype.

Distribution. – (Figs. 42B,167). Ozark Plateau of Missouri, Tennessee, Indiana and Oklahoma.

Etymology. – Latin, *ozarkensis*, in reference to the geographical distribution.

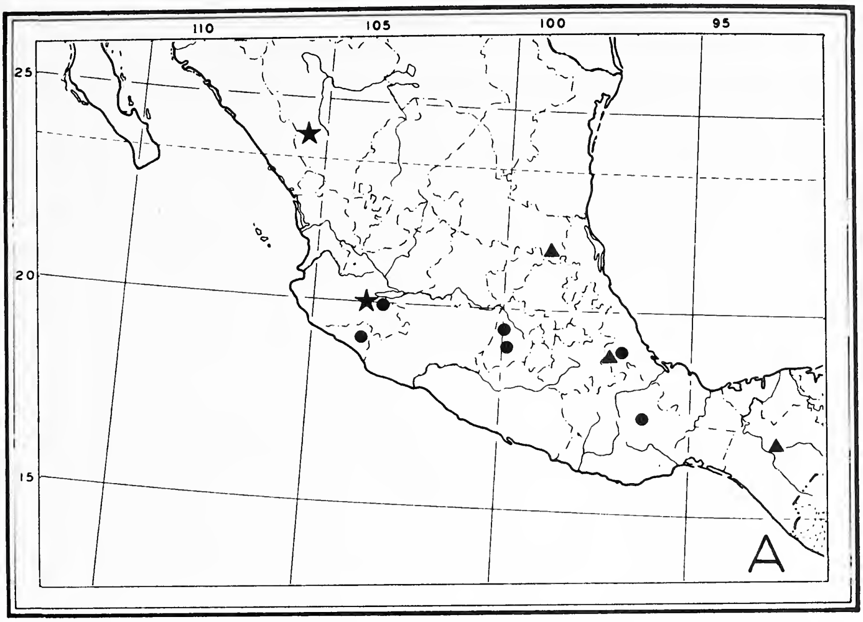
43. *Hydraena maureenae* new species
(Figs. 41C,42B,167)

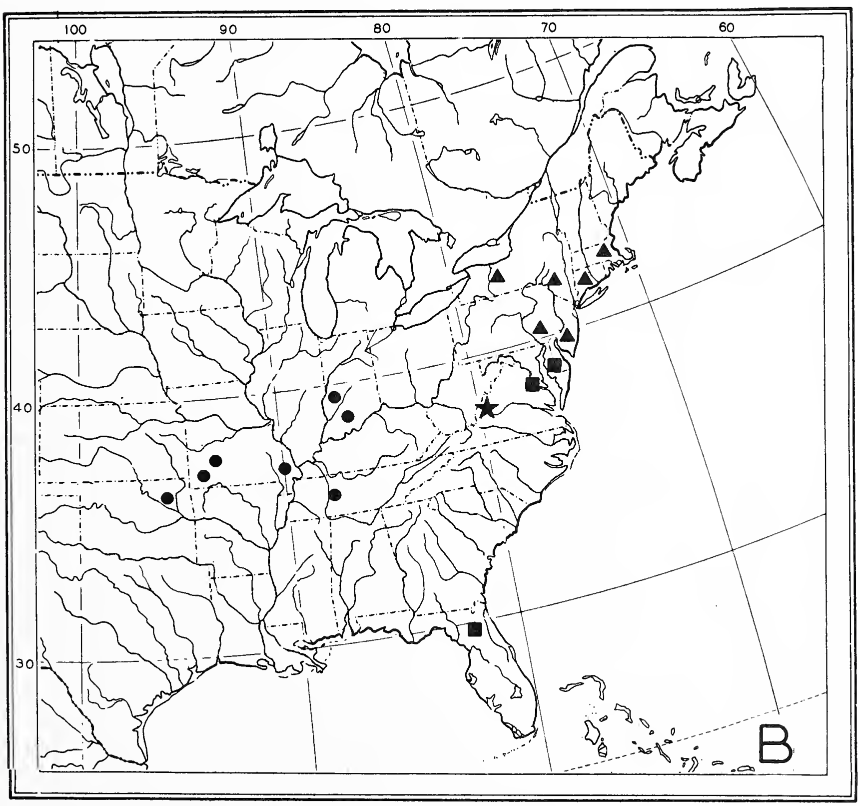
Type-locality. – Twelve miles S. Williamsville, Bath County, Virginia.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. I collected these specimens, October 6, 1973. The following seven paratypes (PDP) were taken at the same locality: 1 female, April 21, 1974; 1 male, June 4, 1974; 1 male, 4 females, April 21, 1975.

Diagnosis. – *H. maureenae* adults are readily distinguished from all other members of the *leechi* Group which have a scintilla, except *H. ozarkensis*, by the random, non-serial arrangement of the punctures on the elytral disc plus its small size, about 1.46 mm long. From *H. ozarkensis* adults, those of *H. maureenae* are distinguished by slightly greater length, narrower body form, distribution (Fig. 42B), and aedeagus (Figs. 41A-C).

Description. – *Form:* Elongate. *Size:* Holotype 1.46 mm long, 0.58 mm wide. *Color:* head with dorsal surface and labrum dark brown; maxillary palpi and antennae testaceous. Pronotum testaceous at anterior and posterior 0.25, reddish brown in center 0.33; elevated areas between external foveolae somewhat lighter than disc. Elytra testaceous, slightly darker than testaceous areas of pronotum. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum testaceous. *Head:* Length 0.20 mm. Width 0.38 mm. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely microreticulate. Labroclypeal suture nearly straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.28/0.12/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33; arcuate in apical 0.66, median surface similarly shaped; palpomere 4 widest at apical 0.33. Mentum wider than long, surface moderately shining, finely punctulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge nearly imperceptible. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.17 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (at approximately midlength) 0.50 mm; sides margined, denticulate; sides well produced at middle, very weakly sinuate and convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.40 mm. wide, straight and nearly perpendicular to midline in lateral 0.20, moderately arcuate to rear in middle 0.60; posterior border 0.40 mm wide, slightly arcuate to rear. Posterointernal foveolae well developed; punctures in foveola closer together than those on disc. Posteroexternal foveolae well developed. Interfoveolar depression well developed. Area between external foveolae clearly elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, occupying slightly less than 0.33 width of anterior region of pronotum. Transverse foveola slightly developed, punctures separated by thin walls. Disc shining, punctures well impressed, separated by 0.50 puncture diameter near anterior and posterior borders, by puncture diameter in middle; some punctures with seta extended above cuticle in dry specimens. Scintilla distinct, flat, impunctate shelf with arcuate anterior and posterior margins. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior median carina extended to base of intercoxal process; intercoxal process relatively broad, sides nearly parallel, apex blunt, width at apex nearly 0.66 distance between internal and median carinae. Metasternum with plaques well developed, triangular, medial margins parallel; plaques 0.40 length of metasternum in midline; greatest width of each plaque 0.66 width of intercoxal process at its midlength; plaques separated posteriorly by approximately twice plaque width; plaques flat in cross section. *Elytra:* Length 0.94 mm. Maximum width (at midlength) 0.58 mm. Surface shining, disc with sutural, second, third and fourth rows of punctures somewhat serial, other punctures randomly arranged; most punctures with seta. Explanate margin narrow, ended near posterior 0.10; with extremely fine serrations near anterior angles and apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen*: Intercoxal segment flat, width twice length; anterior angle rounded; posterior margin arcuate. Glabrous segments at apex moderately produced. Segment 7 without emargination at apex. *Legs:* Protibia with arcuate lateral surface, nearly straight medial surface. Metatibia very slightly wider at midlength than at apex. *Genitalia:* Aedeagus as illustrated (Fig. 41C)(3 examined).





Figs. 42A – B, Geographical distributions of *Hydraena* species. (A) *H. cuspidicollis* ●, *H. prieto* ★ and *H. mexicana* ▲. (B) *H. ozarkensis* ●, *H. maureenae* ★, *H. punctata* ▲ and *H. youngi* ■.

Natural History. – The substratum at the margin of the small stream at the type-locality (Fig. 193B) consisted of small to moderately large, smooth slate fragments. Consocies included a very large population of *Limnebius ozapalachicus* plus a few specimens of *L. discolor* and *L. richmondi.*

Distribution. – (Figs. 42B,167). Presently known only from the type-locality in the Appalachian Mountains of Virginia.

Etymology. – I am very pleased to dedicate this species to my wife Maureen Ellen, who has assisted me in collecting aquatic Coleoptera throughout North and Central America, and who has been a constant source of encouragement during the course of this study.

The *particeps* Subgroup

Members of the *particeps* Subgroup lack a pronotal scintilla and do not have the anteromedial region of the metasternum elevated to form a ridge (cf. the *argutipes* Subgroup). Adults of most of the nine species presently known for this subgroup are quite small.

Geographically, this group ranges from Brazil northward through Central America and the Antilles to southern Mexico and the eastern United States as far north as Massachusetts.

44. *Hydraena orcula* new species
(Figs. 43D,168)

Type-locality. – Ria Chim, Mosquito, Goias, Brazil.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. Harley P. Brown collected these specimens, June 17, 1968.

Diagnosis. – Small size, about 1.16 mm long, and plaque shape serve to distinguish *H. orcula* adults from adults of other species of the *leechi* Group which lack a scintilla and have well developed posterointernal foveolae. The plaques are narrow, about 0.33 the length of the metasternum; the distance separating the plaques being four times the width of a plaque, and equal to the length of a plaque. The aedeagus (Fig. 43D) is unique.

Description. – *Form:* Ovate. *Size:* Holotype 1.16 mm long, 0.50 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum testaceous at anterior and posterior 0.25, dark brown in center 0.50; sides slightly lighter than center. Elytra brown, approximately midway in color between extremes of pronotum. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum testaceous. *Head:* Length 0.16 mm. Width 0.32 mm. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpi missing from holotype, allotype with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.22/0.08/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral and median surfaces slightly arcuate; palpomere 4 widest at apical 0.33. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.28 mm; maximum width (at approximately midlength) 0.40 mm; sides margined, denticulate; sides relatively slightly produced at middle, slightly arcuate and slightly convergent to anterior angle, slightly sinuate and slightly convergent to posterior; anterior border 0.34 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.36 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola closer together than those on disc, some confluent. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression slightly developed. Area between external foveolae weakly elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33

width of anterior region of pronotum. Transverse foveola slightly developed, with punctures closer together than punctures on disc. Disc shining, punctures moderately fine, separated by 0.25 puncture diameter near anterior and posterior borders, by puncture diameter in middle; punctures each with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides parallel, apex rounded, width 0.66 distance between internal and median carinae. Metasternum with plaques well developed, somewhat triangular, median margins nearly parallel; plaques 0.33 length of metasternum in midline; plaques separated posteriorly by approximately plaque length, which is equal to four times plaque width; plaques flat in cross section. *Elytra:* Length 1.16 mm. Maximum width (at midlength) 0.50 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to puncture diameter, as are interstices between adjacent punctures of a row; punctures each with seta. Explanate margin quite narrow, ending near posterior 0.20, with extremely fine serrations at anterior angles. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated very slightly, obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle, posterior margin weakly arcuate. Glabrous segments at apex weakly produced. Apical segment without emargination at apex. *Legs:* Without apparent modification. *Genitalia:* Aedeagus as illustrated (Fig. 43D)(1 examined).

Distribution. – (Fig. 168). Known only from the type-locality in the state of Goias, Brazil.

Etymology. – Latin, *orca* (whale) plus *ula* (diminutive). Named in reference to the shape of the aedeagus.

45. *Hydraena sahlbergi* d'Orchymont
(Fig 168)

Hydraena sahlbergi d'Orchymont, 1923:40 (holotype female in HM; type-locality: Santa Rita, Minas Gerais, Brazil).

Diagnosis. – Readily distinguished from other members of the *leechi* Group found in the same geographical area, (mountains of southeastern Brazil), by absence of a pronotal scintilla. Refer to the diagnosis of *H. spangleri* for additional comments.

Description. – *Form:* Elongate. *Size:* Holotype 1.57 mm long, 0.68 mm wide. *Color:* Head with dorsal surface dark brown; labrum brown; maxillary palpi and antennae testaceous. Pronotum dark brown except testaceous band at anterior and posterior borders; width of band about 0.17 length of pronotum. Elytra brown. Ventral surface brown except legs, elytral epipleura and inflexed margin of pronotum testaceous. *Head:* Length 0.27 mm. Width 0.39 mm. Frons shiny, moderately punctate, interstices one-two times puncture diameter. Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at about midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4 respectively: 0.26/0.09/0.19; palpomere 2 bent outward at about midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight, medial surface arcuate, widest near midlength. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulation similar to mentum. Genae shining, finely punctulate; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation similar to that of submentum. Last five antennomeres pubescent. Eyes 0.17 interocular distance in width. *Thorax:* Pronotum length at midline 0.41 mm; maximum width (at approximately midlength) 0.51 mm; sides margined, denticulate; sides relatively slightly produced at middle, nearly straight and convergent to anterior angle, very slightly sinuate and convergent to posterior; anterior border 0.44 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.48 mm wide, slightly arcuate to rear. Posterointernal foveolae weakly developed; punctures in foveola closer together than those on disc. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression absent. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extneded across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc dull, punctures moderately sized, very deeply impressed, separated by narrow walls near anterior and posterior borders, and by 0.50 puncture diameter in middle; most punctures without distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel, apex blunt, width at apex 0.66 distance between internal and median carinae. Metasternum with plaques well developed, slightly arcuate, convergent moderately from posterior to anterior; each plaque tapered from posterior to anterior; plaques 0.50 length of metasternum in midline; greatest width of each plaque 0.66 width of intercoxal process at its midlength; plaques separated posteriorly by approximately three times plaque width; plaques flat in cross section. *Elytra:* Length 1.02 mm. Maximum width (at midlength) 0.68 mm. Surface shining, disc with 10 rows of

markedly impressed punctures between suture and humeral callus; puncture shape irregular; intervals not elevated, width approximately equal to 0.25 puncture diameter, somewhat irregular due to displacement by punctures; interstices between adjacent punctures of row approximately 0.25 puncture diameter; each puncture with seta. Explanate margin quite narrow, ended near posterior 0.20 with extremely fine, well separated serrations along entire margin. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. *Legs:* Without apparent modification. *Genitalia:* Males unknown.

Distribution. – (Fig. 168). Known only from the type-locality, Santa Rita, Minas Gerais, Brazil.

Remarks. – Other than the holotype I have seen only a single female from the type-locality (BMNH).

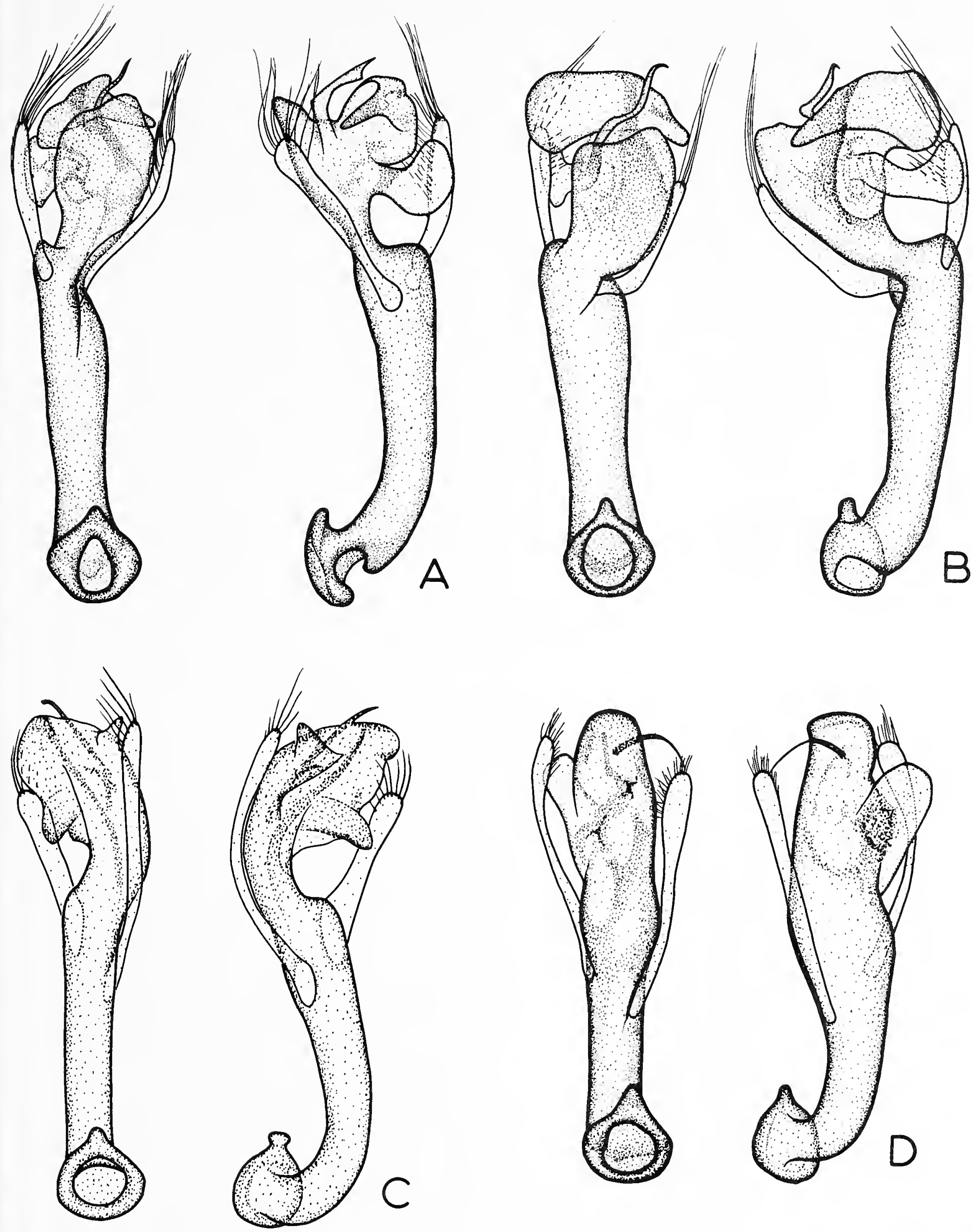
46. *Hydraena particeps* new species
(Figs. 43A-B,59,168)

Type-locality. – Calabozo, 32 km. SW, Guarico, Venezuela.

Type-specimens. – The holotype male, which was collected by Paul J. Spangler, February 11, 1969, is deposited in USNM. The allotype, from Albrook Forest Site, Canal Zone, Panama, is also deposited in USNM. Paratypes (22) are listed in the appendix.

Diagnosis. – The plaques are moderately long and narrow, separated by about four times the width of a plaque. Additionally, the pronotum lacks a scintilla and has well developed posterointernal foveolae, and the metasternum does not have the anteromedial region elevated. These features, plus the distinctive aedeagus (Figs. 43A-B), serve as the diagnostic characteristices for *H. particeps*.

Description. – *Form:* Elongate. *Size:* Holotype 1.40 mm long, 0.48 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum testaceous at anterior and posterior 0.25, dark brown in center 0.50; sides slightly lighter than center. Elytra brown, approximately midway in color between extremes of pronotum. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.20 mm. Width 0.38 mm. Frons moderately punctured, interstices equal to or slightly less than puncture diameter; surface moderately shining; posterior margin very slightly emarginate in midline. Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture nearly straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.26/0.10/0.18; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral and median surfaces slightly arcuate, widest near midlength. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.38 mm; maximum width (at approximately midlength) 0.50 mm; sides margined, denticulate; sides moderately produced at middle, slightly sinuate and convergent to anterior angle, slightly sinuate and convergent to posterior; anterior border 0.42 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.46 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola similar to those on disc. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression weakly developed. Area between external foveolae nearly flat. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola weakly developed, with punctures somewhat closer together than punctures on disc. Disc shining, punctures fine, separated by 0.50 puncture diameter near anterior and posterior borders, by puncture diameter in middle; punctures each with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly into very short spine; coxae separated by a thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior ; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel, apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with plaques well developed, straight, convergent moderately from posterior to anterior; plaques 0.36 length of metasternum in midline: width of each plaque 0.66 width of intercoxal process; plaques separated posteriorly by approximately four times plaque width; plaques flat in cross section. *Elytra:* Length 1.00 mm. Maximum width (at midlength) 0.48 mm. Surface shining, disc with 10 rows of punctures



Figs. 43A – D, Aedeagi of *Hydraena* species. (A) *H. particeps*, holotype. (B) *H. particeps* variant from Honduras. (C) *H. decui*, holotype. (D) *H. orcula*, holotype.

between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to puncture diameter, interstices between adjacent punctures of a row slightly smaller; punctures each with seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine serrations near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin arcuate. Glabrous segments at apex moderately produced. Apical segment without emargination at apex. *Legs:* Protibia with slight emargination on inner surface near midlength. Other legs without apparent modification. *Genitalia:* Aedeagus as illustrated (Figs. 43A-B) (13 examined).

Natural History. – The notation, "pocket of damp leaves in dry streambed", is the only microhabitat information presently available.

Distribution. – (Figs. 59,168). From Honduras south to Panama and east through Venezuela to Trinidad and Grenada.

Variation. – The single male I have seen from Honduras, the northernmost locality known to date, has an aedeagus (Fig. 43B) of slightly different form than the other males studied (Fig. 43A). Externally this specimen is noticably more densely punctate on the pronotum, but agrees quite well in other respects. This specimen might represent another species, but I prefer to treat it as an aedeagal morph until more material from Central America becomes available for study.

Etymology. – Latin, *particeps* (comrade, partner, sharing). Named in reference to the phylogenetic relationship of this species to *H. decui*, as indicated by the aedeagus.

47. *Hydraena decui* Spangler
(Figs. 43C,168)

Hydraena decui Spangler, 1980:329 (holotype male in USNM; type-locality: Arroyo de la Poa, Sabanilla, Cuba).

Diagnosis. – Transverse pronotum, widely separated plaques and aedeagal form serve as diagnostic characteristics for adults of this small, rather broad Cuban species.

Description. – *Form:* Ovate, moderately broad. *Size:* Holotype 1.18 mm long, 0.52 mm wide. *Color:* Entirely testaceous except for dark brown frons and light brown, indistinct pronotal macula. *Head:* Length 0.18 mm, width 0.30 mm. Frons finely, moderately densely punctate, interstices shiny. Frontoclypeal suture slightly arcuate. Clypeus finely punctulate, faintly microreticulate laterally. Labroclypeal suture straight. Labrum microreticulate, bilobed, median emargination ending near midlength. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4 respectively: 0.20/0.08/0.15; palpomere 4 unusually slender, widest near midlength, outer edge straight. Mentum wider than long, dull, microreticulate. Submentum microreticulate. Genae shiny, foveolate laterally. Postgena microreticulate. *Thorax:* Pronotum length at midline 0.29 mm; maximum width (at midlength) 0.43 mm; sides margined, very finely denticulate, distinctly produced at middle, slightly arcuate and convergent to anterior angles, sinuate and convergent to posterior angles; anterior border 0.34 mm wide, straight and perpendicular to midline in lateral 0.25, slightly arcuate to rear in posterior 0.50; posterior border 0.35 mm wide, very slightly arcuate to rear. Posterointernal and posteroexternal foveolae absent. Anteroexternal foveolae well developed, each somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola absent. Disc shiny, finely moderately densely punctate, punctures separated by one-two times puncture diameter; punctures without apparent setae. Scintilla absent. Prosternum carinate; carina between coxae, sinuate in lateral view. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process of moderate width, apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with plaques small, narrow, length about equal to width of intercoxal process, width 0.50 length; plaques separated by about five times plaque width. *Elytra:* Length 0.73 mm. Maximum width (at midlength) 0.52 mm. Disc shiny, with 10 rows of small, close-set punctures between suture and humeral callus; intervals not elevated, width less than puncture diameter, as are interstices between punctures of a row; most punctures with very fine seta. Explanate margin well developed, ending near posterior 0.20, finely serrate. Elytral apices very slightly dehiscent, in posterior aspect elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. *Legs:* Profemur with low carina on inner surface near base. Protibia slightly arcuate. Other legs moderately slender, unmodified. *Genitalia:* Aedeagus as illustrated (Fig. 43C)(1 examined).

Distribution. – (Fig. 168). Cuba.

48. *Hydraena guadelupensis* d'Orchymont (Figs. 44D,59,168)

Hydraena guadelupensis d'Orchymont, 1923:37 (holotype male in ISNB; type-locality: Guadeloupe). – d'Orchymont, 1945a:1-4.

Diagnosis. – Small size, about 1.30 mm long, and the elytral apices which, when viewed posteriorly, do not turn upwards toward the suture serve to distintuish *H. guadelupensis* adults from other members of the *leechi* Group occupying the same geographical area (Fig. 59). Refer to the diagnosis of *H. spangleri* for further comments.

Description. – *Form:* Elongate-oval. *Size:* Holotype 1.30 mm long, 0.55 mm wide. *Color:* Head with dorsal surface dark brown; labrum brown; maxillary palpi and antennae testaceous. Pronotum testaceous except for transverse, rectangular brown (lighter than head) macula on disc approximately 0.18 mm long, 0.30 mm wide; macula at borders blended into surrounding testaceous areas. Elytra same color as pronotal macula. Ventral surface dark brown except legs, plaques, elytral epipleurae and inflexed margin of pronotum brown. *Head:* Length 0.19 mm. Width 0.32 mm. Frons finely and sparsely punctate, interstices one to three times puncture diameter; surface shining. Frontoclypeal suture arcuate to rear. Clypeus microreticulate. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.23/0.10/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, arcuate in apical 0.66, median surface arcuate; apical segment widest near distal 0.33. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulation similar to mentum. Genae shining; lateral area of each gena with a well developed foveola; posterior ridge absent. Postgena with microreticulation similar to that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.32 mm; maximum width (at approximately midlength) 0.55 mm; sides margined, denticulate; sides moderately produced at middle, arcuate and convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.37 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.40 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately devloped; punctures in foveola similar to those on disc. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression weakly developed. Area between external foveolae not elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc shining, punctures fine, separated by twice puncture diameter; most punctures with seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel; apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with plaques well developed, straight, convergent moderately from posterior to anterior; plaques 0.43 length of metasternum in midline; width of each plaque subequal to width of intercoxal process at its midlength; plaques separated posteriorly by approximately twice plaque width; plaques separated anteriorly by 1.50 plaque width; plaques flat in cross section. *Elytra:* Length 0.83 mm. Maximum width (at midlength) 0.55 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to puncture diameter, as are interstices between adjacent punctures of a row; most punctures without perceptible seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine, well separated serrations along entire margin; serrations slightly closer near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin not elevated obliquely toward suture, not in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex only moderately produced. Segment 7 without emargination at apex. *Legs:* Protibia slightly arcuate; other legs without apparent modification. *Genitalia:* Aedeagus as illustrated (Fig. 44D)(21 examined).

Variation. – The aedeagus of the single male I have seen from Costa Rica has the apex slightly different from that of other specimens (Fig. 44D). Length and general proportions of this aedeagus are virtually identical to aedeagi of specimens from Guadeloupe and Jamaica. Externally, this beetle is very slightly smoother than those from the remainder of the distribution. I have examined 59 specimens (see appendix).

Natural History. – The only microhabitat notations present in the locality data are "sifted from swamp litter" and "ex small pool in narrow gully".

Distribution. – (Figs. 59,168). Guadeloupe, Jamaica and Costa Rica.

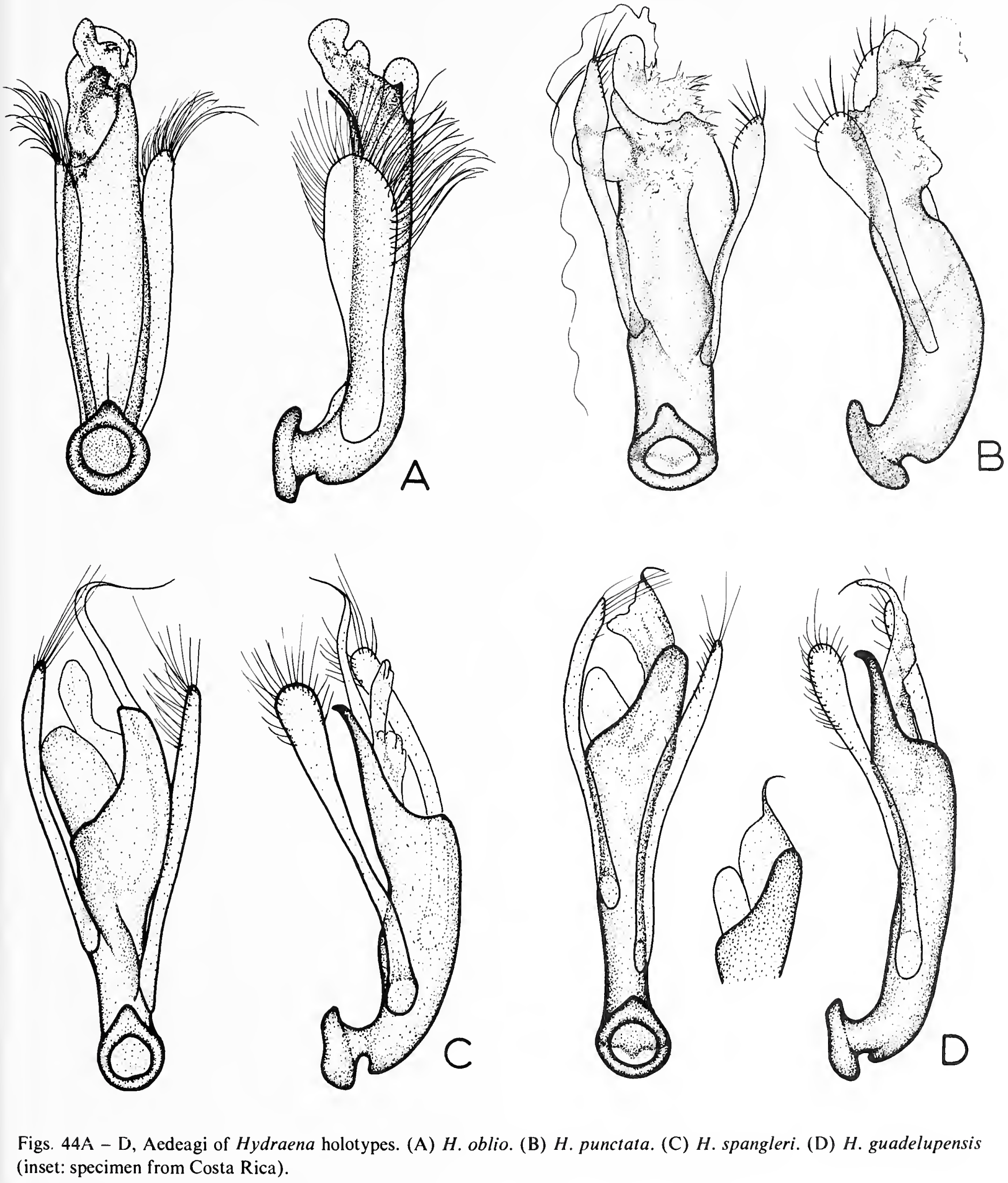
49. *Hydraena spangleri* new species
(Figs. 44C,56B,168)

Type-locality. – Plummer's Island, Montgomery County, Maryland.

Type-specimens. – The holotype male and allotype with identical data are deposited in USNM. Paul J. Spangler collected these specimens, November 1, 1960. Paratypes (150) are listed in the appendix.

Diagnosis. – Small size, about 1.30 mm long, and lack of a distinct pronotal scintilla readily distinguish adults of *H. spangleri* from those of all other species of the *leechi* Group which occupy the same geographical area (Fig. 56B). *H. spangleri* adults are externally very similar to those of the putative sister-species, *H. guadelupensis* from the Antilles and Costa Rica. *H. guadelupensis* adults are slightly narrower, generally less densely punctate and do not have the elytral margins turned upwards toward the suture, in posterior aspect. Aedeagi of males of the two species (Figs. 44C-D) are distinct, but obviously markedly similar. Adults of these two species are similar to those of *H. sahlbergi* in that all three species have (1) serial elytral punctures, (2) lack a median metasternal ridge posterior to the mesosternal process, and (3) have the metasternal plaques convergent anteriorly. *H. sahlbergi* adults however, are larger (about 1.57 mm long), with narrower elytral intervals and are known only from southeastern Brazil.

Description. – *Form:* Elongate-oval. *Size:* Holotype 1.30 mm long, 0.55 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum testaceous at anterior and posterior 0.25, brown in middle 0.50, sides slightly lighter than center. Elytra brown. Ventral surface dark brown except legs, elytral epipleura, apex of abdomen and inflexed margin of pronotum, testaceous. *Head:* Length 0.16 mm. Width 0.32 mm. Frons moderately punctate, interstices equal to or slightly greater than puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3, and 4, respectively: 0.20/0.08/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral and medial surfaces slightly arcuate. Mentum longer than wide, surface moderately shining, finely punctulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly greater than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.32 mm; maximum width (at approximately midlength) 0.46 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.36 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.40 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola closer together than those on disc. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression slightly developed. Area between external foveolae nearly flat. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola slightly developed, with punctures separated by thin walls. Disc shining, punctures fine and close, separated by less than puncture diameter; most punctures with seta extended above cuticle in dry specimens. Scintilla absent, represented by narrow, reflective, impunctate area. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides parallel, apex somewhat rounded, width near apex 0.50 distance between internal and median carinae. Metasternum with plaques well developed, straight, convergent from posterior to anterior; plaques 0.50 length of metasternum in midline; plaques separated posteriorly by approximately twice plaque width; plaques separated anteriorly by approximately plaque width; plaques flat in cross section. *Elytra:* Length 0.86 mm. Maximum width (at midlength) 0.58 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to puncture diameter; interstices between adjacent punctures of row 0.50 puncture diameter; punctures each with seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine serrations near anterior angles and apices. Elytral apices, in dorsal aspect, gradually



Figs. 44A – D, Aedeagi of *Hydraena* holotypes. (A) *H. oblio.* (B) *H. punctata.* (C) *H. spangleri.* (D) *H. guadelupensis* (inset: specimen from Costa Rica).

rounded; in posterior aspect, elytral margin not elevated obliquely toward suture, not in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle, posterior margin very weakly arcuate. Glabrous segments at apex moderately produced. Segment 7 without emargination at apex. *Legs:* Protibia arcuate, enlarged gradually from base to apex. Metatibia straight, gradually enlarged from base to apex. *Genitalia:* Aedeagus as illustrated (Fig. 44C)(72 examined).

Natural History. – H. spangleri appears to be primarily a pond species. Habitat notations in the locality data include "pothole", "pond", "debris at swamp edge", "hardwood hammock", "Palmetto-Mahogany swamp", "under water hyacinth", "grassy compost mixed with Cypress

needles", "litter in sinkhole", and "sphagnum". Adults of *H. spangleri* are frequently collected in association with *H. atlantica* adults in Maryland and with those of *H. marginicollis* in Florida. In one locality record provided by W. Suter, adults were found living in sphagnum with *H. ancylis* adults in Hardin County, Texas.

Distribution. – (Figs. 56B,168). Generally found in, but not restricted to, coastal areas; eastern United States, Maryland to Texas.

Etymology. – It is with pleasure that I dedicate this species to Paul J. Spangler in recognition of his significant contributions to the knowledge of aquatic Coleoptera.

50. *Hydraena punctata* LeConte
(Figs. 42B,44B,168)

Hydraena punctata LeConte, 1855:362 (holotype male in MCZ; type-locality: Pennsylvania).
Hydraena needhami d'Orchymont, 1929:79 (holotype female in ISNB; type-locality: Ithaca, New York; new synonomy).

D'Orchymont's type-specimen does not differ significantly from LeConte's type-specimen. Refer to the remarks section for additional comments.

Diagnosis. – Among those species of the *leechi* Group whose adults lack a scintilla, lack a median, anterior ridge on the metasternum, and have the elytral punctures in series, *H. punctata* adults are distinguished by moderately elongate, widely separated plaques. The plaques converge slightly with one another anteriorly, being separated anteriorly by about four times the width of a plaque. *H. punctata* is distinct also in its distribution, being the only member of the *leechi* Group living in northeastern United States (Fig. 42B).

Description. – *Form:* Elongate. *Size:* Holotype 1.48 mm long, 0.70 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi testaceous except apices brown; antennae testaceous. Pronotum testaceous except for transverse, rectangular, brown (lighter than head) macula on disc which occupies approximately middle 0.56 of pronotum; macula lighter near sides of pronotum and blended into anterior and posterior testaceous areas. Elytra same color as testaceous areas of pronotum. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.20 mm. Width 0.40 mm. Frons punctation coarse, deeply impressed, interstices equal to puncture diameter or less; surface moderately shining. Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture arcuate when viewed from above. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.28/0.10/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, arcuate in apical 0.66, median surface arcuate; apical segment widest near distal 0.33. Mentum wider than long, surface moderately shining, microreticulate laterally. Submentum microreticulate. Genae shining. finely microreticulate, lateral area of each gena with well geveloped foveola; posterior ridge absent. Postgena with microreticulation similar to that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (at approximately midlength) 0.52 mm; sides margined, denticulate; sides moderately produced at middle, sinuate and convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.44 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.46 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola similar to those on disc. Posteroexternal foveola moderately developed. Interfoveolar depression moderately developed. Area between external foveolae moderately elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola slightly developed, punctures closer together than punctures on disc. Disc moderately shining, punctures fine and close together, separated by thin walls near anterior and posterior borders, and by puncture diameter in middle; most punctures with seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel, apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with plaques moderately developed, straight, convergent from posterior to anterior; plaques slightly less than 0.50 length of metasternum in midline; width of each plaque subequal to width of intercoxal process at its midlength; plaques separated anteriorly by approximately four times plaque width; plaques flat in cross section. *Elytra:* Length 1.10 mm. Maximum width (at midlength) 0.55 mm. Surface moderately shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.50 puncture

diameter, as are interstices between adjacent punctures of a row; each puncture with seta. Explanate margin quite narrow, ended near posterior 0.17, with extremely fine, well separated serrations along entire margin; serrations somewhat closer near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen*: Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex moderately produced. Segment 7 without emargination at apex. *Legs:* Metatibia gradually enlarged from base to apex. *Genitalia:* Aedeagus as illustrated (Fig. 44B)(13 examined).

Distribution. – (Figs. 42B,168). Northeastern United States: Massachusetts, Connecticut, New York, New Jersey and Pennsylvania.

Remarks. – In the original description of *H. punctata*, LeConte (1855) gives the length of his specimen as "Long. .95", which is equivalent to about 2.40 mm. This is apparently a typographical error, as the specimen is actually only 1.48 mm long. D'Orchymont (1923) in his early paper on American *Hydraena* comments that he had not seen the type-specimen of *H. punctata*, and states further, "Je n'ai vu aucune *Hydraena* americaine de taille ausse grande." This probably explains why d'Orchymont later (1929) mistakenly described a specimen of *H. punctata* as *H. needhami*. Including the two types, a total of 26 specimens were examined (see appendix).

51. *Hydraena oblio* new species
(Figs. 44A,59,168)

Type-locality. – Four miles S. Rabinal, Baja Verapaz, Guatemala.

Type-specimens. – The holotype male and allotype with same data are deposited in USNM. My wife Maureen and I collected these specimens, June 10, 1974. Paratypes (13) are listed in the appendix.

Diagnosis. – Small size and ovate body form (about 1.24 x 0.56 mm), plus pronotal sculpture, which lacks a scintilla and has the interstices microreticulate, serve as diagnostic characteristics for this distinctive species. The pronotum is very dull due to the microreticulation.

Description. – *Form:* Ovate. *Size:* Holotype 1.24 mm long, 0.56 mm wide. *Color:* Dorsal surface dark brown except head and disc of pronotum nearly black; maxillary palpi and antennae brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.20 mm. Width 0.34 mm. Frons microreticulate, punctures separated by less than their own diameters, microreticulation more evident in punctures than on interstices; surface dull. Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture nearly straight when viewed from above. Labrum bilobed, microreticulate, each lobe slightly asymmetrical; median emargination ending at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.20/0.08/0.14; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface very slightly arcuate, median surface moderately arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge very slightly developed. Postgena with punctation slightly smaller than that of submentum. Last five antennomeres pubescent. Eyes 0.17 interocular distance in width. *Thorax:* Pronotum length at midline 0.32 mm; maximum width (at approximately midlength) 0.46 mm; sides margined, denticulate; sides moderately produced at middle, very slightly sinuate and slightly convergent to anterior angle, markedly sinuate, and convergent to posterior; anterior border 0.36 mm wide, straight and nearly perpendicular to midline in lateral 0.17, moderately arcuate to rear in middle 0.50; posterior border 0.40 mm wide, slightly arcuate to rear. Posterointernal foveolae well developed; punctures in foveola less distinct than those on disc. Posteroexternal foveola well developed. Interfoveolar depression moderately developed. Area between external foveolae moderately elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola moderately developed, punctures similar to those on disc. Disc dull, microreticulate, punctures separated by 0.50 puncture diameter or less, some punctures with seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel; apex round, width 0.50 distance between internal and median carinae.

Metasternum with plaques weakly developed, consisting of small ovals at posterior 0.20. *Elytra:* Length 0.82 mm. Maximum width (at midlength) 0.56 mm. Surface dull, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round but limits difficult to discern, surface uneven; intervals not elevated, width approximately equal to 0.50 puncture diameter, as are interstices between adjacent punctures of row; each puncture with seta. Explanate margin quite narrow, ended near posterior 0.12, with fine serrations near anterior angles. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle, posterior margin straight. Glabrous segments at apex moderately produced. Segment 7 without emargination at apex. *Legs:* Protibia arcuate, very slightly expanded in apical 0.33. Metatibia with straight inner surface, outer surface very slightly arcuate. *Genitalia:* Aedeagus as illustrated (Fig. 44A)(6 examined).

Natural History. – The stream at the type-locality is in a transition xeric-tropical zone, the beetles being collected at the sand-gravel margins (Figs. 191B-C).

Distribution. – (Figs. 59,168). Inhabits the mountains of Guatemala and Chiapas, Mexico.

Etymology. – *oblio*, a miscellaneous assemblage of letters.

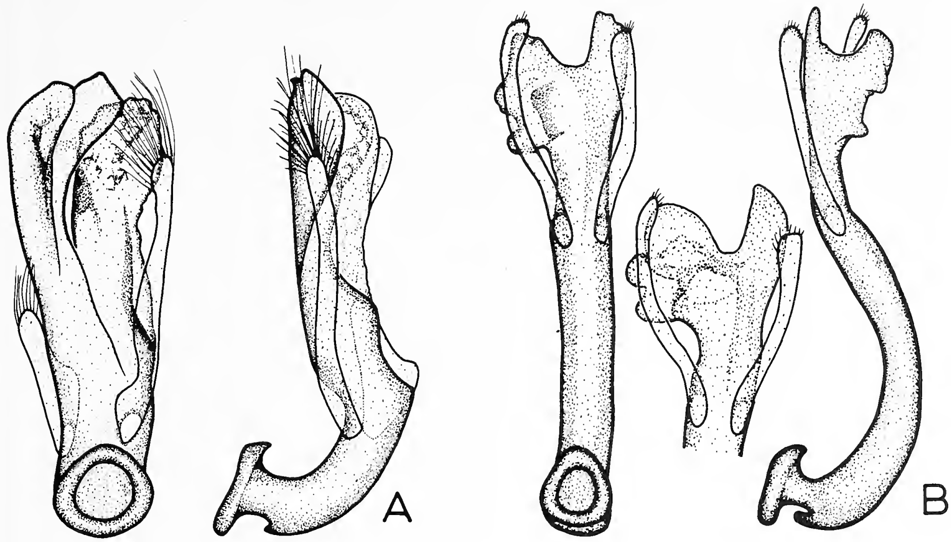
52. *Hydraena youngi* new species
(Figs. 42B,45B,168)

Type-locality. – San Felasco Hammock, Alachua County, Florida.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in CFMNH. Paratypes with same data (12) are deposited in FNY, USNM, and PDP. Frank N. Young collected these specimens, October 28, 1947. One additional male paratype (PDP) has the following data: Maryland, Worcester County, Pokomoke City, October 16, 1977, H. E. Sprance. One additional female paratype (PDP), collected by Hubbard and Schwarz, is from Ft. Monroe, Virginia.

Diagnosis. – Immediately distinguished from other Western Hemisphere *Hydraena* adults by narrow body form (1.96 x 0.56 mm) and rugulose, dull pronotum. The aedeagus (Fig. 45b) is extremely unusual.

Description. – *Form:* Narrow, elongate. *Size:* Holotype 1.96 mm long, 0.56 mm wide. *Color:* Head with dorsal surface dark brown; labrum brown; maxillary palpi and antennae testaceous. Pronotum with an indistinctly defined, brown macula on disc, remainder testaceous. Elytra brown. Ventral surface brown except legs, elytral epipleurae and inflexed margins of pronotum ochraceous. *Head:* Length 0.20 mm. Width 0.34 mm. Frons moderately finely and closely punctured; interstices equal to or slightly less than puncture diameter, surface dull, extremely uneven, limits of punctures difficult to see with light reflected from surface. Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc, median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.26/0.12/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, arcuate in apical 0.66, median surface arcuate; palpomere 4 widest past midlength. Mentum wider than long, surface dull, microreticulate. Submentum microreticulate. Genae dull, lateral area of each gena with well developed foveola; posterior ridge nearly imperceptible. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.38 mm; maximum width (at approximately midlength) 0.48 mm; sides margined, denticulate; sides relatively weakly produced at middle, very slightly arcuate and slightly convergent to anterior angle, markedly sinuate and slightly convergent to posterior; anterior border 0.40 mm wide, straight and nearly perpendicular to midline in lateral 0.14, markedly arcuate to rear in middle 0.71; posterior border 0.44 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola similar to those on disc. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression very slightly developed. Area between external foveolae not elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc dull, punctures fine, separated by 0.50 puncture diameter near anterior and posterior borders, by puncture diameter in middle; interstices extremely uneven, limits of punctures difficult to see with light reflected from surface; punctures with distinctive setae extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina arcuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of



Figs. 45A – B, Aedeagi of *Hydraena* holotypes. (A) *H. cuspidicollis.* (B) *H. youngi* (inset: specimen from Worcester County, Maryland).

intercoxal process; intercoxal process relatively narrow, tapered from base to apex, apex blunt, width at apex slightly less than 0.50 distance between internal and median carinae. Metasternum with plaques well developed, triangular, median margins parallel; plaques nearly 0.50 length of metasternum in midline; plaques flat in cross section. *Elytra:* Length 1.04 mm. Maximum width (at midlength) 0.56 mm. Surface dull, disc with 10 rows of punctures between suture and humeral callus, rows 2-5 (from suture) somewhat irregular; most punctures round; intervals not elevated, width approximately equal to puncture diameter, as are interstices between adjacent punctures of a row; surface of interstices somewhat uneven; punctures each with seta. Explanate margin quite narrow, ended near posterior 0.20, with fine serrations near anterior angles. Elytral apices, in dorsal aspect, somewhat produced; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle, posterior margin arcuate. Glabrous segments at apex well produced, somewhat flat on ventral surface. Apical segment without emargination at apex. *Legs:* Profemur with a small tubercle on inner surface at midlength. Protibia very slightly arcuate. *Genitalia:* Aedeagus as illustrated (Fig. 45B)(7 examined).

Variation. – The aedeagus of the single male known from Maryland (Fig. 45B, inset) differs slightly from that of specimens from Florida. Externally, this specimen agrees well with the Floridian individuals.

Distribution. – (Figs. 42B,168). Known only from the type-locality in Florida and one locality in Maryland.

Etymology. – I am pleased to dedicate this species to Frank N. Young, in recognition of his many contributions to the knowledge of way of life and systematics of aquatic Coleoptera.

The *argutipes* Subgroup

Adults of this subgroup are characterized by absence of a pronotal scintilla, absence of a brush of hairs on the metatibiae of males, and the presence of an elevated ridge, more or less

developed, on the anteromedial region of the metasternum (e.g.*H. cuspidicollis*), (Fig. 48D). Adults of several of the eight included species have the pronotum distinctively incised on the sides in the posterior 0.50. Two of the species, *H. bractea* and *H. bractoides*, have the male metatibiae arcuate and expanded.

As is currently known, the subgroup is restricted to montane areas of Mexico from Oaxaca to Durango.

53. *Hydraena oaxaca* new species
(Figs. 46D,169)

Type-locality. – One mile N. Ixtlan de Juarez, Oaxaca, Mexico.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. Paratypes consist of two specimens, one of each sex, from the same locality (PDP). These specimens were collected by my wife Maureen and I, July 5, 1974.

Diagnosis. – The metasternal plaques are well developed, subtriangular, separated by slightly more than the greatest width of a plaque. This characteristic plus the well developed median ridge on the anterior portion of the metasternum and the moderately large size, about 1.70 mm long, serve to distinguish *H. oaxaca* adults from the other members of the *leechi* Group which have serial punctures on the elytra and lack a pronotal scintilla.

Description. – *Form:* Elongate. *Size:* Holotype 1.70 mm long, 0.72 mm wide. *Color:* Dorsal surface dark brown except border of pronotum, slightly lighter. Maxillary palpi testaceous; antennae testaceous. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.22 mm. Width 0.40 mm. Frons moderately punctured, interstices equal to or slightly less than puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus microreticulate, Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.28/ 0.10/0.22; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface straight, median surface arcuate; apical segment widest near midlength. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (at approximately midlength) 0.56 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and slightly convergent to anterior angle, slightly sinuate and convergent to posterior; anterior border 0.44 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.48 mm wide, slightly arcuate to rear. Posterointernal foveolae weakly developed; punctures in foveola similar to those on disc. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression moderately developed. Area between external foveolae moderately elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola slightly developed, with punctures somewhat closer together than punctures on disc. Disc shining, punctures moderately large and deeply impressed, separated by thin walls near anterior and posterior borders, by puncture diameter or slightly less in middle; each puncture with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median median carina extended to base of intercoxal process; interocoxal process relatively broad, sides parallel, apex blunt, width at apex subequal to distance between internal and median carinae. Metasternum with ridge posterior to intercoxal process; plaques well developed, somewhat triangular, parallel; plaques 0.50 length of metasternum in midline, greatest width of each plaque subequal to width of intercoxal process; plaques separated posteriorly by approximately 1.50 times plaque width; plaques flat in cross setion. *Elytra:* Length 1.08 mm. Maximum width (at midlength) 0.72 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to puncture diameter, interstices between adjacent punctures of row generaly smaller than puncture diameter; punctures each with seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine, well separated serrations along entire margin; serrations somewhat closer near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle, posterior margin straight. Glabrous segments at apex only moderately produced. Segment 7

emarginate at apex. *Legs:* Profemur with small tubercle on inner surface at basal 0.50. Protibia arcuate in basal 0.50, expanded on inner surface near apical 0.33. Metatrochanter with small tubercle. Metatibia gradually enlarged from base to apex; basal 0.25 slightly arcuate. *Genitalia:* Aedeagus as illustrated (Fig. 46D)(2 examined).

Natural History. – The type-series was removed from leaves and other debris which had become trapped behind rocks in a moderately large stream. This stream was in a pine-oak transition area (Fig. 195B). Consocies included *H. scintilla* and *H. cuspidicollis.*

Distribution. – (Fig. 169). Known only from the type-locality at the base of the mountains just north of the small village of Ixtlan de Juarez. This village is approximately 25 miles north of the city of Oaxaca.

Etymology. – Latin-like noun in apposition, *oaxaca*, in reference to the type-locality.

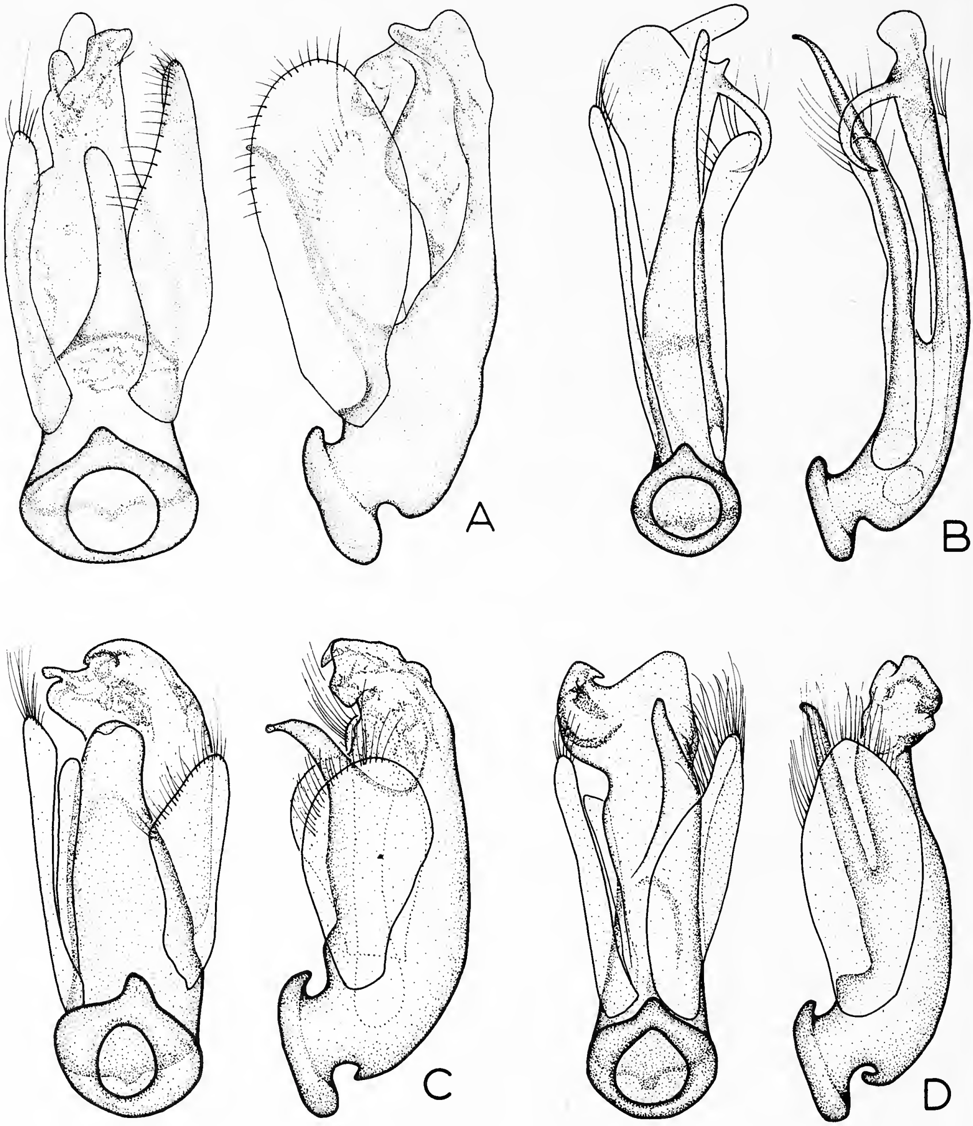
54. *Hydraena scolops* new species
(Figs. 46C,169)

Type-locality. – Real de Arriba, Temescaltepec, Mexico, Mexico.

Type-specimen. – The holotype male (unique) is deposited in BMNH. This specimen was collected by H. E. Hinton and R. L. Usinger in 1932.

Diagnosis. – Differentiated from other species in the *leechi* Group whose adults also lack a pronotal scintilla, have a low ridge on the metasternum posterior to the mesosternal intercoxal process, have a relatively broad intercoxal process, and have the elytral punctures in series, by shape and size of the plaques, which are shaped as elongate triangles. The inner margins are parallel, while the outer margins converge anteriorly so that the anterior extreme of each plaque is acute. The plaques are separated by slightly less than the basal width of a plaque. Males have a very small, pointed process on the posterior margin of the metatrochanter.

Description. – *Form:* Elongate-oval. *Size:* Holotype 1.48 mm long, 0.64 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi brown; antennae brown. Pronotum brown at anterior and posterior 0.50, dark brown in center 0.50; sides slightly lighter than center. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.20 mm. Width 0.36 mm. Frons moderately punctured, most interstices slightly greater than puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture nearly straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.26/0.12/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, arcuate in apical 0.66, median surface arcuate; apical segment widest near midlength. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (at approximately midlength) 0.48 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and convergent to anterior angle, slightly sinuate and convergent to posterior; anterior border 0.38 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.42 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola closer together than those on disc. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression slightly developed. Area between foveolae weakly elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola slightly developed, with punctures closer together than punctures on disc. Disc shining, punctures fine, separated by 0.50 puncture diameter near anterior and posterior borders by puncture diameter or slightly greater in middle; punctures each with seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad, sides nearly parallel, apex round, width slightly less than distance between internal and median carinae. Metasternum with prominent ridge immediately posterior to intercoxal process; plaques well developed, triangular, medial surfaces parallel; plaques nearly 0.50 length of metasternum in midline; greatest width of each plaque subequal to width of intercoxal process; plaques separated by approximately greatest width of plaque; plaques flat in cross section. *Elytra:* Length 0.96 mm. Maximum width (at



Figs. 46A – D, Aedeagi of *Hydraena* holotypes. (A) *H. crystallina.* (B) *H. mazamitla.* (C) *H. scolops.* (D) *H. oaxaca.*

midlength) 0.64 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width slightly less than puncture diameter, as are interstices between adjacent punctures of a row; punctures each with seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine serrations near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle, posterior margin straight. Glabrous segments at apex moderately produced. Segment 7 without emargination at apex. *Legs:* Profemur with minute tubercle on inner surface at midlength. Protibia expanded on inner surface near apical 0.33. Metatrochanter with acute tubercle on posterior margin. Metatibia parallel sided in

apical 0.66. *Genitalia:* Aedeagus as illustrated (Fig. 46C)(1 examined).

Distribution. – (Fig. 169). Known only from the type-locality near Temescaltepec in the state of Mexico, Mexico.

Etymology. – Greek, *skolops* (thorn). This name refers to the small, pointed process on the hind margin of the metatrochanters.

55. *Hydraena crystallina* new species
(Figs. 46A,169)

Type-locality. – Seven miles S. Mazamitla, Jalisco, Mexico.

Type-specimens. – The holotype male and allotype with identical data are deposited in USNM. These specimens were collected by my wife Maureen and I, July 15, 1974. Paratypes consist of one male and two females (PDP) with same data as holotype plus five males and eight females (CAS) collected by Hugh B. Leech at the type-locality, December 1, 1948.

Diagnosis. – Among those species of the *leechi* Group whose adults have an anterior median ridge on the metasternum and have the mesosternal intercoxal process relatively broad, adults of *H. crystallina* are distinguished by the plaques, which are narrow, non-elevated and separated by more than twice the width of a plaque.

Description. – *Form:* Elongate. *Size:* Holotype 1.38 mm long, 0.60 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum testaceous at anterior and posterior 0.25, dark brown in middle 0.50; sides slightly lighter than center. Elytra brown. Ventral surface dark brown except legs, elytral epipleura mentum and inflexed margin of pronotum testaceous. *Head:* Length 0.20 mm. Width 0.34 mm. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely punctulate. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed; surface punctulate; each lobe symmetrical arc; median emargination ended above midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.26/0.10/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface very slightly arcuate; median surface evenly arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface moderately shining, finely punctulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly greater than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.34 mm; maximum width (at approximately midlength) 0.48 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and convergent to anterior angle, slightly sinuate and convergent to posterior; anterior border 0.38 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.42 mm wide, slightly arcuate to rear. Posterointernal foveolae weakly developed; punctures in foveola closer together than those on disc. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression slightly developed. Area between external foveolae slightly elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc shining, punctures fine, separated by approximately puncture diameter; punctures each with distinctive seta extended above cuticle in dry specimens. Scintilla absent, margin very slightly produced in this area. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad, sides nearly parallel in apical 0.50, apex blunt, width at apex subequal distance between internal and median carinae. Metasternum with ridge posterior to intercoxal process; plaques well developed, somewhat triangular, convergent slightly from posterior to anterior; plaques 0.41 length of metasternum in midline; width of each plaque 0.33 width of intercoxal process at its midlength; plaques separated posteriorly by approximately three times plaque width; plaques flat in cross section. *Elytra:* Length 0.90 mm. Maximum width (at midlength) 0.60 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to puncture diameter, as are interstices between adjacent punctures of a row; punctures each with seta. Explanate margin quite narrow, ended near posterior 0.10, with extremely fine, well separated serrations along entire margin; serrations somewhat closer near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle, posterior margin straight. Glabrous segments at apex moderately produced. Segment 7 emarginate at

apex. *Legs:* Profemur with minute tubercle on inner surface near midlength. Protibia slightly expanded on inner surface near apical 0.33. Metatibia slightly wider at middle than at apex. *Genitalia:* Aedeagus as illustrated (Fig. 46A)(7 examined).

Natural History. – Refer to *H. scopula.*

Distribution. – (Fig. 169). Known only from the type-locality near Mazamitla in the state of Jalisco, Mexico.

Etymology. – Latin, *crystallina* (of crystal). Named in reference to the transparency of the aedeagus.

56. *Hydraena mazamitla* new species
(Figs. 46B,169)

Type-locality. – Seven miles S. of Mazamitla, Jalisco, Mexico.

Type-specimens. – The holotype male and allotype with same data are deposited in CAS. Hugh B. Leech collected these specimens, December 1, 1948.

Diagnosis. – Small size, about 1.36 mm long, moderately shiny pronotum, lack of a scintilla, weakly elevated anteromedial ridge on the metasternum, and plaque form are the primary differentiating external features of this species. The plaques are well developed, convergent anteriorly, separated posteriorly by nearly twice plaque width, and rounded in cross-section. The aedeagus (Fig. 46B) is very distinctive.

Description. – *Form:* Elongate. *Size:* Holotype 1.36 mm long, 0.60 mm wide. *Color:* Head with dorsal surface brown, darker near eyes; labrum brown; maxillary palpi testaceous; antennae testaceous. Pronotum with brown macula on disc, surrounding areas testaceous. Elytra brown. Ventral surface brown except legs, elytral epipleura and inflexed margin of pronotum light brown. (This specimen appears to be slightly teneral.) *Head:* Length 0.20 mm. Width 0.34. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.24/0.12/0.18; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, arcuate in apical 0.66, median surface evenly arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface shining, finely punctulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.32 mm; maximum width (at approximately midlength) 0.48 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and slightly convergent to anterior angle, slightly sinuate and convergent to posterior; anterior border 0.38 mm wide, straight and nearly perpendicular to midline in lateral 0.25; moderately arcuate to rear in middle 0.50; posterior border 0.42 mm wide, slightly arcuate to rear. Posterointernal foveolae slightly developed; punctures in foveola closer together than those on disc. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression slightly developed. Area between external foveolae weakly elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, occupying slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc shining, punctures fine, separated by puncture diameter near anterior and posterior borders, and by twice puncture diameter in middle; most punctures with seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel, apex blunt, width at apex 0.66 distance between internal and median carinae. Metasternum with median, anterior ridge; plaques well developed, triangular, convergent very slightly from posterior to anterior; plaques nearly 0.50 length of metasternum in midline, greatest width of each plaque subequal to width of intercoxal process; plaques separated posteriorly by slightly greater than plaque width; plaques slightly rounded in cross section. *Elytra:* Length 0.84 mm. Maximum width (at midlength) 0.60 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.50 puncture diameter, as are interstices between adjacent punctures of a row; punctures each with a seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine serrations near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of

angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex moderately produced. Segment 7 without emargination at apex. *Legs:* Profemur with tubercle on inner surface near basal 0.33. Protibia slightly expanded on inner surface near apical 0.33. Mesotibia flattened on inner surface near apex. Metatibia nearly parallel sided in apical 0.50. *Genitalia:* Aedeagus as illustrated (Fig. 46B)(1 examined).

Natural History. – Refer to *Hydraena scopula.*

Distribution. – (Fig. 169). Known only from the type-locality near Mazamitla, Jalisco, Mexico.

Etymology. – Latin-like noun in apposition, *mazamitla*, in reference to the type-locality.

57. *Hydraena prieto* new species
(Figs. 42A,47A,169)

Type-locality. – One mile W. Los Bancos, Durango, Mexico.

Type-specimens. – The holotype male and allotype with same data are deposited in USNM. My wife Maureen and I collected these specimens, July 17, 1974. Paratypes (29) are listed in the appendix.

Diagnosis. – The metasternal plaques are very narrow, slightly elevated, and widely separated, the distance being about five times the width of a plaque. Form of the plaques plus the shiny, moderately sparsely punctate pronotum serve to distinguish *H. prieto* adults from other members of the *leechi* Group which lack a scintilla and have the anteromedial region of the metasternum elevated.

Description. – *Form:* Elongate. *Size:* Holotype 1.50 mm long, 0.66 mm wide. *Color:* Dorsal surface dark brown, nearly black, except narrow brownish border around pronotum; maxillary palpi testaceous; antennae testaceous. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.22 mm. Width 0.40 mm. Frons finely and sparsely punctured, interstices two-three times puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely microreticulate, shiny. Labroclypeal suture arcuate when viewed from above. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.24/0.12/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight, median surface evenly arcuate; palpomere 4 widest near midlength. Mentum wider than long; surface moderately shining, finely microreticulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (at approximately midlength) 0.54 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.44 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.46 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola similar to those on disc. Posteroexternal foveola moderately developed, with punctation somewhat closer than that of disc. Interfoveolar depression moderately developed. Area between external foveolae weakly elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed. Disc shining, punctures fine, separated by two-three times puncture diameter; punctures each with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly into very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad, sides nearly parallel; apex blunt, width at apex slightly less than distance between internal and median carinae. Metasternum with ridge posterior to intercoxal process; plaques moderately developed, thin, very slightly carinate, convergent moderately from posterior to anterior; plaques 0.50 length of metasternum in midline; width of each plaque 0.33 width of intercoxal process at its midlength; plaques separated posteriorly by nearly four times plaque width; plaques located on sides of median depression, therefore sloped toward midline. *Elytra:* Length 0.96 mm. Maximum width (at midlength) 0.66 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to puncture diameter or slightly greater, as are interstices between adjacent punctures of a row; punctures each with a seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine, well separated serrations near anterior angles and apices. Elytral apices, in dorsal aspect,

gradually rounded; viewed posteriorly, elytral margin rises obliquely towards suture, forming an angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex moderately produced. Segment 7 apparently not emarginate at apex (obscured by pubescence). *Legs:* Protibia expanded on inner surface at apical 0.33. Mesotibia flattened on inner surface at apex. Metatibia gradually expanded from base to apex. *Genitalia:* Aedeagus as illustrated (Fig. 47A)(19 examined).

Natural History. – The stream at the type-locality is rather rapid, flowing through a pine forest. The beetles were taken at the sand-gravel margin, as were a few specimens of *Ochthebius mexcavatus*. Adults of this species were also found in association with *Hydraena alternata*, "ex under stones in a small creek in the mountains".

Distribution. – (Figs. 42A,169). Found in the mountains of Durango and Jalisco, Mexico.

Etymology. – *prieto*, in reference to Prieto Mountain in the mountains of Durango near the type-locality. The name also refers to the dark coloration of this species.

Remarks. – Los Bancos is a small village near the type-locality, which is about 100 miles west of Durango, on highway MEX. 40.

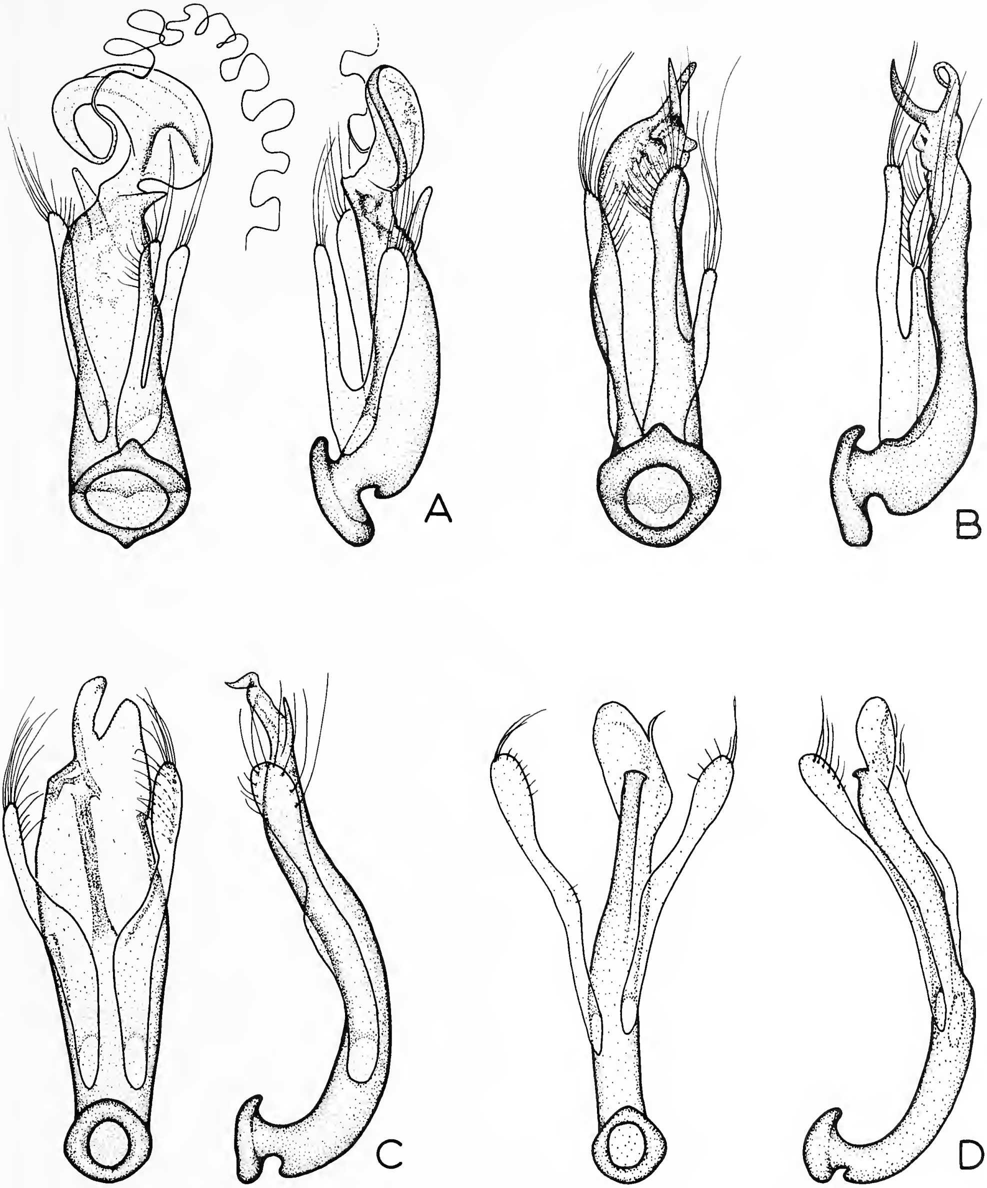
58. *Hydraena argutipes* new species
(Figs. 47B,169)

Type-locality. – Two miles E. of Durango-Sinaloa boundary on highway MEX. 40, 7000 feet, Durango, Mexico.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in CAS. These specimens plus 10 paratypes (8 CAS; 2 PDP) from the same locality were collected by D. E. Breedlove and J. F. Copp, December 30, 1962.

Diagnosis. – The metasternal plaques are well developed, have the lateral margins elevated slightly, and are separated by slightly more than the width of a plaque. This feature, plus the ochraceous legs and palpi serve to distinguish *H. argutipes* adults from those of other species of the *leechi* Group which also lack a pronotal scintilla and have the anteromedial region of the metasternum elevated.

Description. – *Form:* Elongate. *Size:* Holotype 1.46 mm long, 0.64 mm wide. *Color:* Dorsal surface dark brown, nearly black, except narrow brownish border around pronotum; maxillary palpi testaceous, nearly yellow; antennae testaceous. Ventral surface dark brown except legs, elytral epipleura, mentum and inflexed margin of pronotum, brownish-orange. *Head:* Length 0.20 mm. Width 0.36 mm. Frons sparsely punctured, interstices twice puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture arcuate when viewed from above. Labrum bilobed, microreticulate, each lobe a symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.28/0.12/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface slightly arcuate, median surface much more arcuate; apical segment widest near midlength. Mentum wider than long, surface shining, finely microreticulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (at approximately midlength) 0.50 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and convergent to anterior angle, slightly sinuate and convergent to posterior; anterior border 0.40 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.44 mm wide, slightly arcuate to rear. Posterointernal foveolae moderately developed; punctures in foveola closer together than those on disc. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression weakly developed. Area between external foveolae weakly elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc shining, punctures moderately fine, separated by thin walls near anterior and posterior borders, and by puncture diameter or less in middle; many punctures with seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process



Figs. 47A – D, Aedeagi of *Hydraena* holotypes. (A) *H. prieto*. (B) *H. argutipes*. (C) *H. bractea*. (D) *H. bractoides*.

relatively broad, sides nearly parallel in apical 0.50, apex blunt, width at apex subequal to distance between internal and median carinae. Metasternum with prominent ridge posterior to intercoxal process; plaques well developed, somewhat triangular, remarkably reflective, medial margins parallel; plaques 0.50 length of metasternum in midline; greatest width of each plaque 0.66 width of intercoxal process at its midlength; plaques separated posteriorly by slightly less than twice plaque width; plaque lateral margin elevated, each plaque sloped toward midline. *Elytra:* Length 0.94 mm. Maximum width (at midlength) 0.64 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to puncture diameter, as are interstices between adjacent punctures of a row; punctures each with a seta. Explanate margin narrow, ended near posterior 0.20, with extremely fine serrations near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segment at apex moderately produced. Segment 7 emarginate at apex. *Legs:* Profemur with small tubercle on inner surface near midlength. Protibia expanded on inner surface near apical 0.33. Mesotibia flattened on inner surface at apex. Metatibia gradually expanded from base to apex. *Genitalia:* Aedeagus as illustrated (Fig. 47B)(3 examined).

Distribution. – (Fig. 169). Known only from the type-locality in the mountains of Durango, Mexico.

Etymology. – Latin, *arguta* (bright) plus *ipes* (foot). This name refers to the brightly colored, ochraceous legs which contrast attractively with the dark brown dorsum and venter.

59. *Hydraena bractea* new species
(Figs. 47C,169)

Type-locality. – Two miles E. of Durango-Sinaloa boundary on highway MEX. 40, Durango, Mexico.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in CAS. One female paratype with same data is in PDP. These specimens were collected by D. E. Breedlove and J. F. Copp, December 30, 1962.

Diagnosis. – The metasternal plaques of adults of this species are very distinctive due to their large size and very smooth, extremely shiny surfaces. They lie on the sides of a shallow median depression, occupying about 0.20 of the posterior part of the metasternum. Each plaque is slightly wider than the distance separating them, much wider than the mesosternal process, and tapers slightly anteriorly. The mesosternal process is very narrow, the width of its apex being about 0.20 the distance separating the internal and median carinae. There is a sharp elevated ridge on the metasternum posterior to the mesosternal process, and the pronotum lacks a scintilla. Externally, *H. bractea* males are very similar to those of *H. bractoides*, but the aedeagi are quite dissimilar (Figs. 47C-D). Refer to the diagnosis of *H. bractoides* for further comments.

Description. – *Form:* Ovate. *Size:* Holotype 1.36 mm long, 0.64 mm wide. *Color:* Dorsal surface very dark brown, nearly black, except anterior 0.25 and posterior 0.12 of pronotum brown. Maxillary palpi brown; antennae brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.20 mm. Width 0.36 mm. Frons coarsely punctate, interstices less than puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture straight in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.24/0.12/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface arcuate in basal 0.25, nearly straight in apical 0.75, median surface arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulate. Genae shining; lateral area of each gena with a well developed foveola; posterior ridge absent. Postgena with microreticulation similar to that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (at approximately midlength) 0.50 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and slightly convergent to anterior angle, sinuate and rather markedly convergent to posterior; anterior border 0.40 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.42 mm wide, slightly arcuate to rear. Posterointernal foveolae well developed;

punctures in foveola closer together than those on disc, some confluent. Posteroexternal foveolae well developed, with punctation closer than that of disc. Interfoveolar depression moderately developed. Area between external foveolae moderately elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, occupying slightly less than 0.33 width of anterior region of pronotum. Transverse foveola well developed. Disc dull, punctures of moderate size and deeply impressed; interstices with surfaces somewhat uneven varied from thin walls to puncture diameter; most punctures with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine: coxae separated by thin, median carina; carina a sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina continued to base of intercoxal process; intercoxal process extremely narrow, sides tapered, apex somewhat carinate, width at apex 0.20 distance between internal and median carinae. Metasternum with median keel posterior to intercoxal process; plaques markedly developed, straight, median margins parallel; plaques 0.54 length of metasternum in midline; width of each plaque four-five times width of intercoxal process at its apex; plaques separated by approximately 0.66 plaque width; plaques highly reflective. *Elytra:* Length 0.92 mm. Maximum width (at midlength) 0.64 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.50 puncture diameter, as are interstices between adjacent punctures of a row; each puncture with a seta. Explanate margin moderately developed, ended near apices, without perceptible serrations along margin. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin not elevated obliquely toward suture, not in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle, posterior margin straight. Glabrous segments at apex missing from specimen. *Legs:* Protibia arcuate; apical 0.33 expanded on inner surface. Metatrochanter with carina. Metafemur broad, lateral surface arcuate, medial surface sinuate. Metatibia arcuate; apical 0.50 expanded. *Genitalia:* Aedeagus as illustrated (Fig. 47C)(1 examined).

Distribution. – (Fig. 169). Known only from the type-locality in the mountains of Durango, Mexico.

Etymology. – Latin, *bractea* (thin metal plate, gold leaf). This name refers to the smooth, very reflective plaques.

60. *Hydraena bractoides* new species
(Figs. 47D,169)

Type-locality. – 24 miles W. La Ciudad, Durango, Mexico.

Type-specimens. – The holotype male (unique) is deposited in CNC. This specimen was collected by H. F. Howden, June 15, 1964.

Diagnosis. – *H. bractoides* adults are very similar to those of *H. bractea* in habitus appearance and form of the metasternal plaques (refer to the diagnosis of *H. bractea* for a description of the plaques). Additionally, they share the following features: (1) absence of a pronotal scintilla, (2) very thin mesosternal process, its width being about 0.20 the distance separating the internal and median carinae, and (3) presence of an anteromedial ridge on the metasternum. *H. bractoides* adults differ from those of *H. bractea* in their more deeply impressed posterointernal foveolae, less rounded elytral sides, and, in males, the more strongly expanded hind tibiae. These differences are very minor indeed when compared to the differences in aedeagi (Figs. 47C-D).

Description. – *Form:* Ovate. *Size:* Holotype 1.34 mm long, 0.60 mm wide. *Color:* Dark brown. *Head:* Length 0.24 mm; width 0.34 mm. Frons coarsely punctate; interstices equal to or less than puncture diameter; shining. Frontoclypeal suture arcuate. Clypeus finely punctulate in middle, microreticulate laterally. Labroclypeal suture straight. Labrum bilobed, microreticulate; median emargination ending at about midlength. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.20/ 0.10/0.14; palpomere 4 with medial surface more markedly arcuate than lateral. Mentum width equal length, moderately shiny, finely microreticulate. Submentum microreticulate. Genae shiny, lateral area of each gena with well developed foveola; posterior ridge absent. Postgena microreticulate. *Thorax:* Pronotum length at midline 0.34 mm; maximum width (slightly before midlength) 0.48 mm; sides margined, denticulate, moderately produced at middle, slightly arcuate and slightly convergent to anterior angles, sinuate and rather markedly convergent to posterior angles; anterior border 0.38 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.40 mm wide, slightly arcuate to rear. Posterointernal foveolae well developed, deep; punctures in foveola closer together than those on disc, some confluent.

Posteroexternal foveolae well developed, punctation similar to that on disc. Interfoveolar depression moderately developed. Area between external foveolae moderately elevated. Anteroexternal foveolae well developed, each extended slightly less than 0.33 width of anterior region of pronotum. Transverse foveola well developed, punctures closer together than those on reliefs. Disc moderately dull, densely, moderately coarsely punctate, most punctures with distinctive seta; interstices shiny. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process narrow, carinate, width at apex 0.33 distance between internal and median carinae. Metasternum with low median carina behind intercoxal process; plaques large, parallel, very shiny, in slight depression; each plaque width three times that of intercoxal process, length 0.60 that of metasternum in midline; plaques separated by 0.66 plaque width. *Elytra:* Length 0.88 mm. Maximum width (at midlength) 0.60 mm. Surface dull, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width about equal to 0.50 puncture diameter, as are interstices between adjacent punctures of a row; each puncture with an indistinct seta. Explanate margin rather well developed, ended near apices, without perceptible serrations along margin. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin not elevated obliquely toward suture, not in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle, posterior margin straight. Glabrous segments at apex not distinctively produced. *Legs:* Protibia arcuate, apical 0.33 expanded on inner surface. Metafemur moderately broad, lateral surface arcuate, median surface sinuate. Metatibia arcuate, apical 0.50 expanded. *Genitalia:* Aedeagus as illustrated (Fig. 47D)(1 examined).

Distribution. – (Fig. 169). Known only from the type-locality near La Ciudad in the state of Durango, Mexico.

Etymology. – Latin, *bractoides*, in reference to the similarity to *Hydraena bractea.*

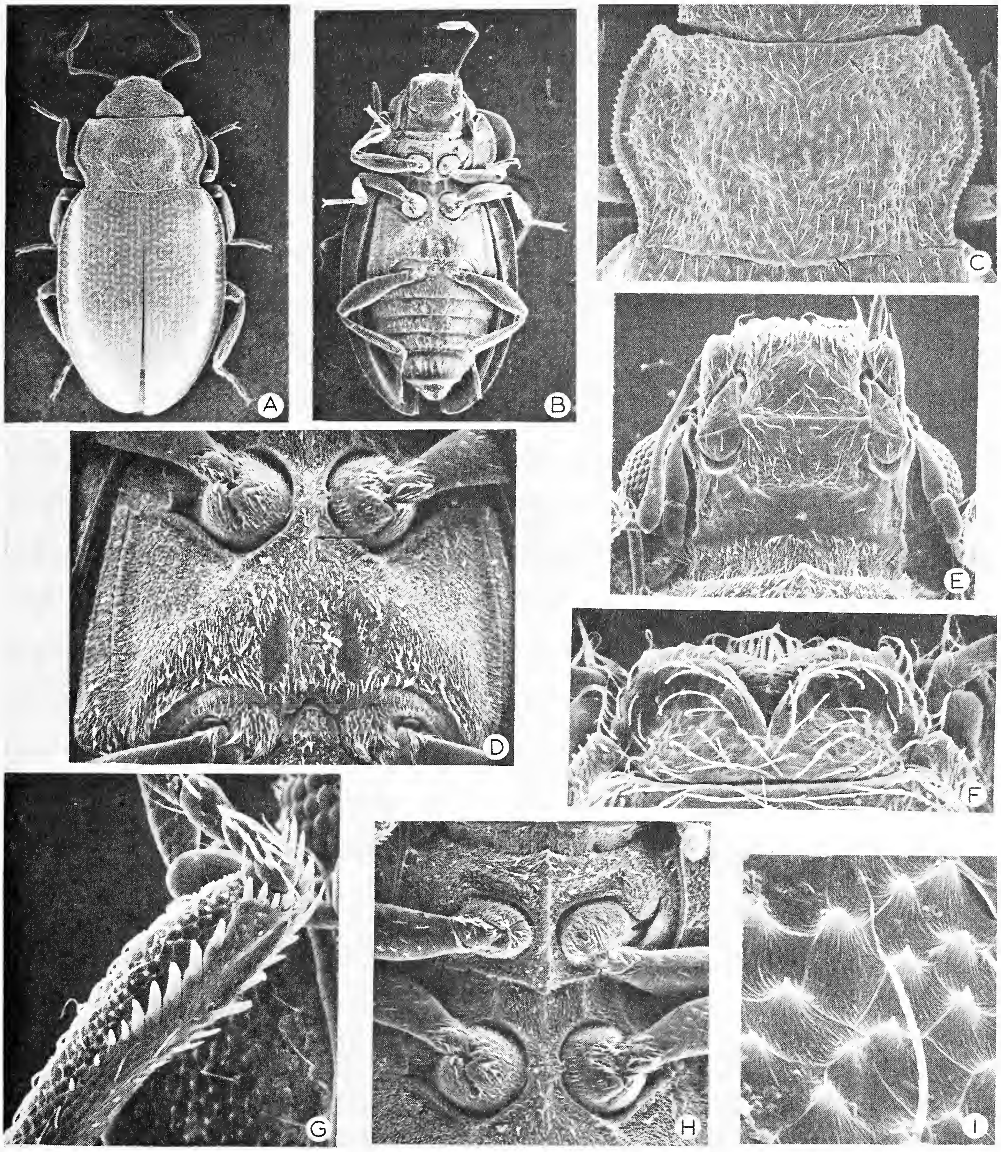
61. *Hydraena cuspidicollis* new species
(Figs. 42A,45A,48A-I,61E-H,169)

Type-locality. – One mile N. Ixtlan de Juarez, Oaxaca, Mexico.

Type-specimens. – The holotype male and allotype with identical data are deposited in USNM. My wife Maureen and I collected these specimens, July 5, 1974. Paratypes (72) are listed in the appendix.

Diagnosis. – Immediately distinguished from adults of other Western Hemisphere *Hydraena* by the broad, depressed body form and pronotal shape, with anterior angles produced (Figs. 48A,C).

Description. – *Form:* Ovate. *Size:* Holotype 1.60 mm long, 0.80 mm wide. *Color:* Dorsal surface dark brown, except pronotum with faint testaceous border. Maxillary palpi testaceous; antennae testaceous. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum orange-brown. *Head:* Length 0.20 mm. Width 0.42 mm. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter; surface moderately shining, setae quite prominent. Frontoclypeal suture straight. Clypeus finely punctulate. Labroclypeal suture nearly straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively; 0.24/0.10/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight, median surface arcuate; palpomere 4 widest near midlength. Mentum wider than long, surface moderately shining, finely microreticulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with punctation similar to that of submentum. Last five antennomeres pubescent. Eyes 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (at approximately midlength) 0.62 mm; sides with furrow, denticulate at sides, upper surface finely, extremely densely punctured; rather markedly produced at middle, slightly arcuate and slightly convergent to anterior angle, markedly sinuate and markedly convergent to posterior; anterior border 0.48 mm wide, angles produced anteriorly, lateral 0.20 arcuate to rear, in form of recessed area, receptacle for posterior margin of eye, middle 0.60 slightly arcuate to rear; posterior border 0.52 mm wide, slightly arcuate to rear. Posterointernal foveolae markedly developed; punctures in foveola similar to those on disc. Posteroexternal foveola well developed, with punctation somewhat less distinct than that of disc. Interfoveolar depression moderately developed. Area between external foveolae well elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, occupying 0.33 width of anterior region of pronotum. Transverse foveola moderately developed, with punctures somewhat closer together than punctures on disc. Disc shining, punctures moderately large and deeply impressed, separated by puncture diameter; most punctures with distinctive seta extended above cuticle in dry specimens. scintilla absent. Prosternum carinate, carina



Figs. 48A – I, *Hydraena cuspidicollis*, ♀. (A) dorsal habitus. (B) ventral habitus. (C) pronotum (arrows indicate pronotal sensilla). (D) metasternum (arrow indicates ridge posterior to intercoxal process). (E) head, ventral aspect. (F) labrum, dorsal aspect. (G) protibia. (H) pro- and mesosternum. (I) detail of inflexed pronotal margin.

produced anteriorly as very short spine; coxae separated from median carina by thin shelf; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad, sides nearly parallel, apex blunt, width at apex 0.66 distance between internal and median carinae. Metasternum with median ridge posterior to intercoxal process; plaques well developed, somewhat triangular, nearly parallel; plaques 0.41 length of metasternum in midline; greatest width of each plaque subequal to width of intercoxal process; plaques separated posteriorly by approximately twice plaque width; plaques on sides of median depression, sloped toward midline. *Elytra:* Length 1.08 mm. Maximum width (at midlength) 0.80 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width slightly greater than puncture diameter, interstices between adjacent punctures of row generally smaller than puncture diameter; each puncture with seta. Explanate margin relatively broad, extended nearly to apices, with fine serrations near anterior angles. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated extremely slightly, obliquely toward suture, in form of slight angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle, posterior margin arcuate. Glabrous segments at apex slightly produced. Segment 7 without emargination at apex. *Legs:* Protibia arcuate, enlarged in apical 0.50. Metatrochanter with small tubercle. Metatibia arcuate in basal 0.50, enlarged and with brush of hairs in apical 0.50 (Figs. 61E-H). All tarsi with prominent setae. *Genitalia:* Aedeagus as illustrated (Fig. 45A)(3 examined).

Natural History. – Refer to *Hydraena scintilla* for notes concerning the type-locality. Refer also to the natural history notes of *Hydraena scopula* and *Spanglerina ingens*.

Distribution. – (Figs. 42A,169). Central Mexico, in the states of Jalisco, Nayarit, Mexico, Veracruz and Oaxaca.

Etymology. – Latin, *cuspidis* (pointed end) plus *collis* (neck). This epithet refers to the produced anterior angles of the pronotum.

Remarks. – Of the 73 specimens known to date, only three are males.

The *marginicollis* Group

Adults of *marginicollis* Group are quite similar to those of the *leechi* Group in many respects, but lack the posterointernal foveolae of the pronotum seen in the latter.

Many species in this group are comprised of quite small members that are very similar to one another externally. The aedeagi, however, are very complex in many instances, and generally differ greatly between species.

The group is very widespread, found from northern Argentina to the southern United States (Fig. 160).

The *marginicollis* Subgroup

Adults of species included in the *marginicollis* Subgroup have the procoxae separated by a thin carina and the mesosternal process is relatively narrow compared to that of adults of the *geminya* Subgroup (cf. Figs. 54B,I,63A-B,F). Except for a very few species, such as *H. anisonycha*, *H. d-destina* and *H. barricula*, the metatibiae of males are unmodified. Male protibiae, however, are usually modified in some manner, generally with an excavation on the inner surface near the apex (Figs. 54G-H). Males of many species have the last abdominal segments greatly produced (e.g. Fig. 63B).

Many of the species included in this subgroup are small and very similar to one another externally. The aedeagus, however, shows remarkable differences between species, and should be examined when members of this Subgroup are studied. The species complexes used herein are based upon aedeagal affinities. Most of these complexes are quite consistent with biogeographical data (see section on phylogeny).

The *marginicollis* Subgroup, which currently consists of 30 species, ranges from the eastern United States south through Mexico, Central America and the Antilles to northern Argentina. The greatest species diversity is in the mountains of southern Mexico (Chiapas) and Guatemala, where eight species are found. This statistic should be viewed with some scepticism, however, since this geographical area has seen more specialized collecting than some other areas, especially the highlands of South America.

The *mexicana* Complex

62. *Hydraena tucumanica* new species
(Figs. 49A,170)

Type-locality. – 20 kilometers S. Tucuman, Tucuman Province, Argentina.

Type-specimens. – The holotype male, allotype and one female paratype, all with identical locality data, are deposited in USNM. Paul and Phyllis Spangler collected these specimens, May 23, 1969.

Diagnosis. – The aedeagus must be used to reliably distinguish *H. tucumanica* males from those of other species of the *marginicollis* Subgroup which also have serial elytral punctures and small oval plaques.

Description. – *Form:* Elongate. *Size:* Holotype 1.40 mm long, 0.60 mm wide. *Color:* Dorsum of head black; pronotum brown at margins, diffuse black macula on disc; elytra brown. Venter dark brown, nearly black. Legs with basal 0.50 of femur brown, remainder testaceous. Maxillae, antennae, inflexed margin of pronotum, and elytral epipleura testaceous. *Head:* Length 0.22 mm; width 0.36 mm. Frons closely, moderately coarsely punctate, punctures separated by about 0.50 puncture diameter, interstices shiny. Frontoclypeal suture slightly arcuate. Clypeus punctate in midline, microreticulate laterally. Labroclypeal suture straight. Labrum bilobed, microreticulate, median emargination ended at about midlength. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4 respectively: 0.22/0.10/0.18; palpomere 4 asymmetrical, widest near distal 0.33. Mentum width equal length, densely, finely punctulate. Submentum microreticulate. Genae shiny, foveolate laterally; posterior ridge absent. Postgena microreticulate. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (at midlength) 0.46 mm; sides margined, denticulate, slightly produced at middle, slightly arcuate and slightly convergent to anterior angles, very slightly sinuate and slightly convergent to posterior angles; anterior border 0.38 mm wide, straight and nearly perpendicular to midline in lateral 0.17, moderately arcuate to rear in middle 0.66; posterior border 0.42 mm wide, very slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveolae extremely shallow, nearly imperceptible. Interfoveolar depression shallow. Anteroexternal foveolae well developed, each somewhat crescent shaped, extended across 0.25 width of anterior region of pronotum. Transverse foveola absent. Disc moderately shiny, densely, deeply, moderately coarsely punctate, most punctures separated by less than puncture width; each puncture with fine seta. Scintilla absent. Prosternum carinate, coxae separated by thin carina, carina sinuate in lateral view. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with small oval plaques at posterior 0.20. *Elytra:* Length 0.88 mm. Maximum width (at midlength) 0.60 mm. Disc moderately shiny, with 10 slightly irregular rows of deep, moderately large punctures between suture and humeral callus; intervals not elevated, width about 0.50 puncture width; interstices between punctures of row about 0.25 puncture width; each puncture with seta. Explanate margin narrow, ended near posterior 0.20. Elytral border very finely serrate. Elytral apices slightly truncate in dorsal view; in posterior aspect elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle, posterior margin straight. Glabrous segments at apex produced. Tergum 7 emarginate at apex. *Legs:* Protibia slightly arcuate, gradually increased in size from base to apex. Other legs without apparent modification, slender. *Genitalia:* Aedeagus as illustrated (Fig. 49A)(1 examined).

Distribution. – (Fig. 170). Known only from the type-locality near Tucuman, Tucuman Province, Argentina.

Etymology. – Latin, *tucumanica*, in reference to the known distribution.

63. *Hydraena quechua* new species
(Figs. 49B,50B,170)

Type-locality. – Babahoyo, Los Rios Province, Ecuador.

Type-specimens. – The holotype male and allotype with identical data are deposited in USNM. Paratypes (8 males, 7 females) from the same locality, collected by A. Langley and J. Cohen, June 21, 1975, are deposited in USNM and PDP. Additional paratypes (10 males, 11 females) are deposited in USNM: 5.5 miles N. Nobel, Guayas Province, Ecuador, January 12, 1978, P. J. Spangler collector.

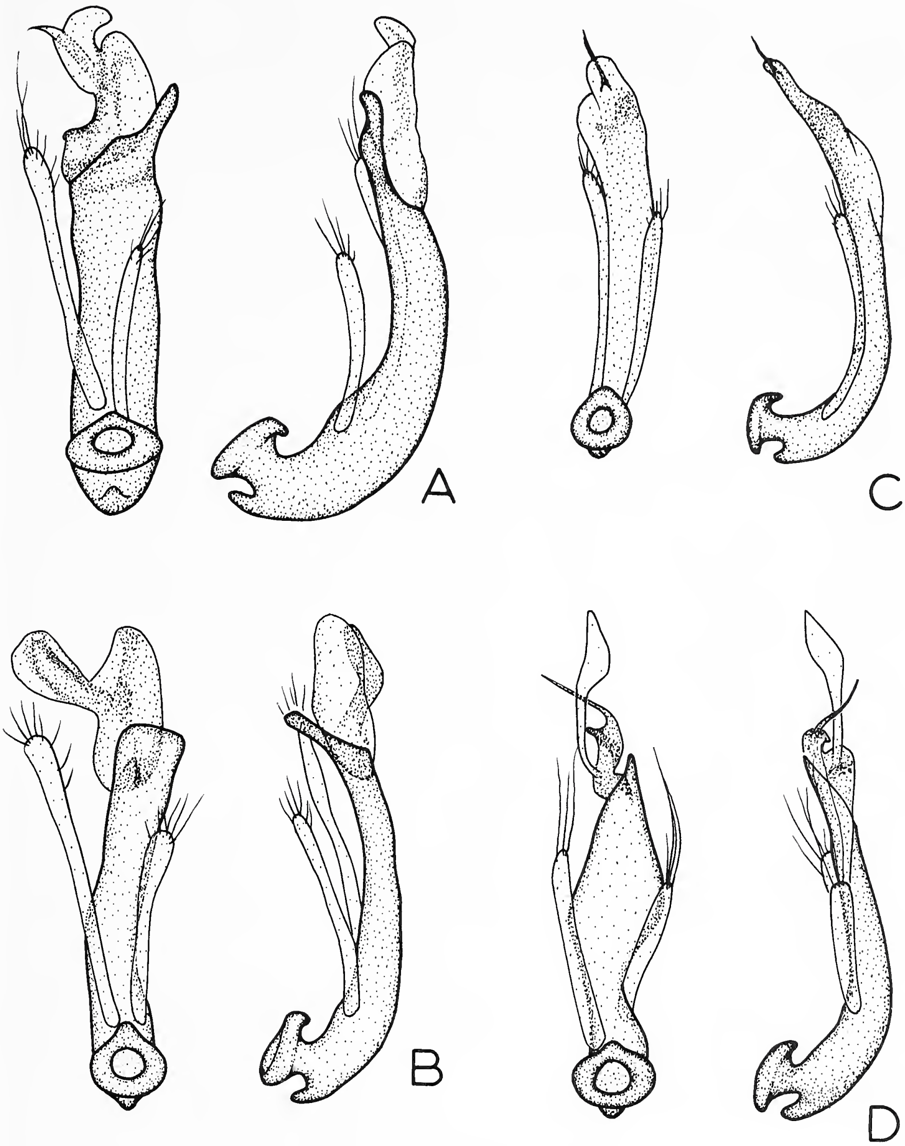
Diagnosis. – Readily distinguished from *Hydraena jivaro*, the only other *Hydraena* now known from Ecuador, by smaller size (1.22 vs 1.48 mm) and black labrum of its adults. The labrum of *Hydraena jivaro* is testaceous. The aedeagus must be studied to reliably distinguish males of *Hydraena quechua* from other similarly sized and sculptured members of the *marginicollis* Subgroup.

Description. – *Form:* Elongate. *Size:* Holotype 1.22 mm long, 0.54 mm wide. *Color:* Dorsum with labrum, clypeus and frons black; pronotum with transverse black macula occupying area from anterior 0.28 to posterior 0.14, remainder testaceous; elytra brown. Venter dark brown. Legs with basal 0.50 of femur brown, remainder testaceous. Maxillae, inflexed margin of pronotum, and elytral epipleura testaceous. *Head:* Length 0.20 mm; width 0.32 mm. Frons moderately punctate, most punctures separated by puncture diameter, interstices shiny. Frontoclypeal suture slightly arcuate. Clypeus shiny in midline, microreticulate and dull laterally. Labroclypeal suture straight. Labrum bilobed, median emargination ending at midlength, microreticulate. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4 respectively: 0.22/0.10/0.16; palpomere 4 asymmetrical, greatest width near apical 0.33. Mentum width equal length, shiny, finely punctulate. Submentum microreticulate. Genae shiny, foveolate laterally; posterior ridge absent. Postgena microreticulate. *Thorax:* Pronotum length at midline 0.30 mm; maximum width (at midlength) 0.42 mm; sides margined, denticulate, slightly produced at middle, slightly sinuate and slightly convergent to posterior angles; anterior border 0.36 mm wide, straight and nearly perpendicular to midline in lateral 0.17, moderately arcuate to rear in middle 0.66; posterior border 0.38 mm wide, very slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveolae extremely shallow, nearly imperceptible. Interfoveolar depression very shallow. Anteroexternal foveolae well developed, each somewhat crescent shaped, extended across about 0.25 width of anterior region of pronotum. Transverse foveola absent. Disc shiny, punctures slightly elongate, separated by puncture diameter near anterior and posterior borders, by twice this distance in middle; punctures without apparent setae. Scintilla absent. Prosternum carinate; coxae separated by thin median carina, carina sinuate line in lateral view. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with well developed parallel plaques, separated by about three times plaque width, 0.33 length of metasternum; each plaque about as wide as apex of intercoxal process. *Elytra* Length 0.78 mm. Maximum width (at midlength) 0.54 mm. Disc shiny, with 10 rows of moderate sized punctures between suture and humeral callus; intervals not elevated, width slightly less than puncture width, as are interstices between punctures of a row; punctures with very fine seta. Explanate margin slightly developed, ended near posterior 0.20. Elytral border from posterior 0.20 to apices finely serrate. Elytral apices somewhat truncate in dorsal view; viewed posteriorly, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle, posterior margin straight. Glabrous segments at apex produced. Tergum 7 emarginate at apex. *Legs:* Protibia slightly arcuate, increased gradually in size from base to apex. Other legs slender, apparently unmodified. *Genitalia:* Aedeagus as illustrated (Fig. 49B)(10 examined).

Natural History. – The specimens from Babahoyo were taken at ultraviolet light and most are teneral, indicating pupation occurs in June, at least. The specimens from Nobol were collected from a roadside pool (January).

Distribution. – (Figs. 50B,170). Presently known from Los Rios and Guayas Provinces, Ecuador.

Etymology. – Noun in apposition, Latin in form, in reference to the Quechua Indians of Ecuador.



Figs. 49A – D, Aedeagi of *Hydraena* holotypes. (A) *H. tucumanica*. (B) *H. quechua*. (C) *H. limpidicollis*. (D) *H. newtoni*.

64. *Hydraena limpidicollis* new species
(Figs. 49C,170)

Type-locality. – Rio Frijoles, 4.1 miles NW Gamboa, Canal Zone, Panama.

Type-specimens. – The holotype male and allotype with identical data are deposited in USNM. Paratypes (6 males, 7 females) from same locality are deposited in MCZ, USNM and PDP. These specimens were collected by A. F. Newton, February 19, 1976.

Diagnosis. – Testaceous pronotum, small size, metasternal depression shape and aedeagus serve as diagnostic features. Adults differ from those of *Hydraena newtoni*, the only other species characterized by a testaceous pronotum, by the unicolorous elytra, smaller size, smaller metasternal depression and aedeagal form.

Description. – *Form:* Ovate. *Size:* Holotype 1.00 mm long, 0.48 mm wide. *Color:* Pronotum testaceous, contrasting markedly with dark brown head and elytra; legs, maxillae, deflexed margin of pronotum and elytral epipleura testaceous; venter dark brown. *Head:* Length 0.18 mm; width 0.28 mm. Frons finely sparsely punctate, interstices one-two times puncture diameter, shining. Frontoclypeal suture straight. Clypeus transversely depressed, shiny in middle, microreticulate laterally. Labroclypeal suture arcuate. Labrum bilobed, median emargination ended at about midlength. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4 respectively: 0.18/0.06/0.14; palpomere 4 very slightly asymmetrical. Mentum wider than long, shiny, very finely punctulate. Submentum shiny, finely sparsely punctulate. Genae shiny, foveolate laterally; posterior ridge absent. Postgena microreticulate. *Thorax:* Pronotum length at midline 0.24 mm; maximum width (at midlength) 0.34 mm; sides margined, denticulate, straight in middle, arcuate to anterior angles, slightly sinuate to posterior angles; anterior border 0.30 mm wide, straight and nearly perpendicular to midline in lateral 0.17, slightly arcuate to rear in middle 0.66; posterior border 0.30 mm wide, slightly arcuate to rear. Posterointernal and posteroexternal foveolae absent. Anteroexternal foveolae well developed, crescent shaped, each occupying about 0.25 width of anterior region of pronotum. Transverse foveola absent. Disc shiny, finely, moderately sparsely punctate. Scintilla absent. Prosternum carinate; coxae separated from carina by very thin shelf; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina absent; intercoxal process broad, width at apex equal distance between internal carina and midline. Metasternum with triangular depression extended across posterior 0.50 in midline; plaques small, thin, on sides of triangular depression. *Elytra:* Length 0.62 mm. Maximum width (at midlength) 0.48 mm. Disc shiny, with 10 indistinct rows of shallow punctures between suture and humeral callus; intervals not elevated, width one-two times puncture diameter, like interstices between punctures of row; punctures with very fine seta. Explanate margin narrow, ended near posterior 0.20; without apparent serrations. Elytral apices, in dorsal aspect, rounded; in posterior aspect, elytral margin not elevated obliquely toward suture, not in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle; posterior margin straight. Glabrous segments not produced. *Legs:* Protibia very slightly arcuate, other legs apparently unmodified, very slender. *Genitalia:* Aedeagus as illustrated (Fig. 49C)(7 examined).

Natural History. – These specimens were extracted (using a Berlese funnel) from wet leaves and flood debris collected at the margin of the Rio Frijoles.

Distribution. – (Fig. 170). Known only from the type-locality near Gamboa in the Canal Zone, Panama.

Etymology. – Latin, *limpid* (transparent) plus *collis* (neck). Specimens of *Hydraena limpidicollis*, when in alcohol, have the pronotum very transparent, so much so that the front legs and posterior part of the head are visible through the marginal areas. The pronotum becomes more opaque upon drying.

65. *Hydraena newtoni* new species
(Figs. 49D,170)

Type-locality. – Rio Frijoles, 4.1 miles NW Gamboa, Canal Zone, Panama.

Type-specimens. – The holotype male and allotype with identical data are deposited in USNM. Paratypes (6 males, 10 females) from same locality are deposited in MCZ, USNM, and PDP. These specimens were collected by A. F. Newton, February 19, 1976.

Diagnosis. – Distinguished from all Western Hemisphere *Hydraena*, except *Hydraena limpidicollis*, by the testaceous pronotum; differs from the latter by (1) slightly larger size, (2) presence of a diffuse light brown area on elytral disc, (3) broader, deeper, U-shaped metasternal depression, (4) presence of a protibial tooth in males, and (5) aedeagal form

(Fig. 49D).

Description. – *Form:* Ovate. *Size:* Holotype 1.12 mm long, 0.50 mm wide. *Color:* Pronotum testaceous, head and elytra dark brown except for diffuse light brown area on disc; venter dark brown; legs, palpi, mentum and apex of abdomen testaceous. *Head:* Length 0.20 mm; width 0.29 mm. Frons finely moderately sparsely punctate, interstices 0.5-2.0 times puncture diameter, shining. Frontoclypeal suture straight. Clypeus transversely depressed, shiny in middle, microreticulate laterally. Labroclypeal suture arcuate. Labrum bilobed, median emargination ended at about midlength. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4 respectively: 0.19/ 0.08/0.16; palpomere 4 very slightly asymmetrical. Mentum wider than long, shiny, very finely punctulate. Submentum shiny, finely sparsely punctulate. Genae shiny, foveolate laterally; posterior ridge absent. Postgena microreticulate. *Thorax:* Pronotum length at midline 0.30 mm; maximum width (at midlength) 0.35 mm; sides margined, denticulate, parallel just before middle, arcuate to anterior angles, slightly sinuate and convergent to posterior angles; anterior border 0.32 mm wide, straight and nearly perpendicular to midline in lateral 0.17, slightly arcuate to rear in middle 0.66; posterior border 0.33 mm wide, slightly arcuate to rear. Posterointernal and posteroexternal foveolae absent. Anteroexternal foveolae well developed, cresent shaped, each extended across about 0.25 width of anterior region of pronotum. Transverse foveola absent. Disc shiny, finely, moderately sparsely punctate. Scintilla absent. Prosternum carinate; coxae separated from carina by very thin shelf; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina absent; intercoxal process broad, width at apex equal distance between internal carina and midline. Metasternum with deep, wide U-shaped depression extended across posterior 0.50 in midline; plaques small, thin, at border of U-shaped depression. *Elytra:* Length 0.70 mm; maximum width (at midlength) 0.50 mm. Disc moderately convex, shiny, with 10 indistinct rows of shallow punctures between suture and humeral callus; intervals not elevated, width one-two times puncture diameter as are interstices between punctures of row; punctures with very fine but quite evident seta. Explanate margin narrow, ending near posterior 0.20; without apparent serrations. Elytral apices, in dorsal aspect, rounded; viewed posteriorly, elytral margin not elevated obliquely toward suture, not in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle; posterior margin straight. Glabrous segments not produced. *Legs:* Protibia slightly arcuate, inner surface slightly enlarged and with tooth near apical 0.33; other legs very slender, apparently unmodified. *Genitalia:* Aedeagus as illustrated (Fig. 49D)(7 examined).

Natural History. – These specimens were extracted (using a Berlese funnel) from wet leaves and flood debris collected at the margin of the Rio Frijoles. Also found in this material were specimens of *Hydraena limpidicollis* and *H. pontequula.*

Distribution. – (Fig. 170). Known only from the type-locality near Gamboa in the Canal Zone, Panama.

Etymology. – I am pleased to dedicate this attractive and unusual new species to Alfred F. Newton, Jr., who collected the only specimens known to date.

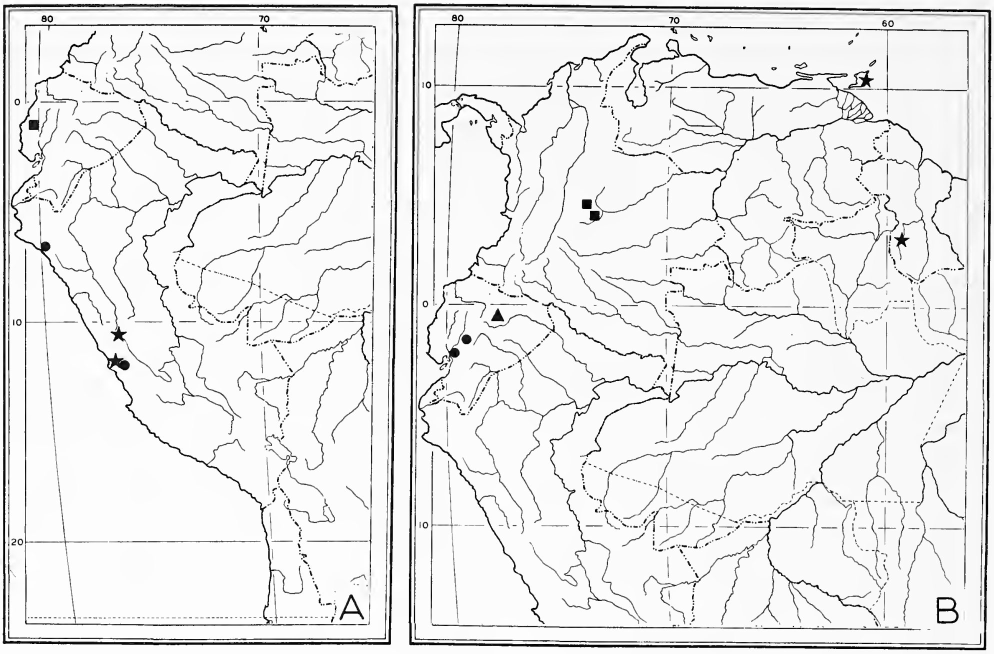
66. *Hydraena guatemala* new species
(Figs. 51A,170)

Type-locality. – 17 miles E. Escuintla, Escuintla, Guatemala.

Type-specimen. – The holotype male (unique) is deposited in USNM. Paul J. Spangler collected this specimen, July 8, 1965.

Diagnosis. – The aedeagus should be used to distinguish *Hydraena guatemala* males from those of other species of the *marginicollis* Subgroup which also have small oval plaques and are relatively small in body length (about 1.26 mm).

Description. – *Form:* Elongate *Size:* Holotype 1.26 mm long, 0.52 mm wide. *Color:* Head with dorsal surface dark brown, nearly black; labrum dark brown; maxillary palpi and antennae testaceous. Pronotum testaceous at anterior and posterior 0.20, dark brown in middle 0.60; sides slightly lighter than disc. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.18 mm. Width 0.34 mm. Frons moderately punctate, interstices equal to or slightly less than puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus microreticulate at sides, shiny in middle. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.24/0.10/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface slightly arcuate, median more markedly arcuate; palpomere 4 widest near apical 0.33. Mentum wider than long, surface shining, finely and sparsely punctulate. Submentum finely, rather sparsely punctulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with punctation slightly larger than that of submentum. Last



Figs. 50A – B, Geographical distributions. (A) *Gymnochthebius peruvianus* ●, *G. bartyrae* ★ and *Parhydraenida pentatenkta* ■. (B) *Hydraena quechua* ●, *H. premordica* ★, *H. jivaro* ▲ and *H. anisonycha* ■.

five antennomeres pubescent. Eyes slightly less than 0.33 interocular distance in width. *Thorax:* Pronotum length at midline 0.32 mm; maximum width (at approximately midlength) 0.42 mm; sides margined, denticulate; sides relatively slightly produced at middle, straight and very slightly convergent to anterior angle, very slightly concave and slightly convergent to posterior; anterior border 0.38 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.40 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola absent. Interfoveolar depression absent. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola absent. Disc shining, punctures fine, separated by one-three times puncture diameter; most punctures with seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior ; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered, apex blunt, width at apex 0.33 distance between internal and median carinae. Metasternum with plaques slightly developed, of small ovals at posterior 0.20; width of each plaque subequal to width of intercoxal process at its apex; plaques separated posteriorly by approximately twice plaque width; plaques flat in cross section. *Elytra:* Length 0.78 mm. Maximum width (at midlength) 0.52 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus; most punctures round; intervals not elevated; width approximately equal to puncture diameter, as are interstices between adjacent punctures of row; each puncture with seta. Explanate margin quite narrow, ended near posterior 0.20, with fine serrations in posterior 0.33; serrations closer near apices. Elytral apices, in dorsal aspect, truncate; in posterior aspect, elytral margin extended obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex moderately produced. Segment 7 emarginate at apex. *Legs:* Profemur with minute tubercle on inner surface near midlength. Protibia enlarged gradually from base to apex, slightly arcuate, very slightly expanded on inner surface near base. Metatibia nearly parallel sided in apical 0.66. *Genitalia:* Aedeagus as illustrated (Fig. 51A)(1 examined).

Distribution. – (Fig. 170). Presently known only from the type-locality near Escuintla, Guatemala.

Etymology. – Noun in apposition, Latin in form, *guatemala*, in reference to the known distribution.

67. *Hydraena haitensis* new species
(Figs. 51B,170)

Type-locality. – Etang Lachaux, SW peninsula, under 1000 feet, Haiti.

Type-specimen. – The holotype male (unique) is deposited in MCZ. P.J. Darlington collected this specimen, October 26-27, 1934.

Diagnosis. – The geographical distribution (Haiti), small size (about 1.28 mm), and moderately developed plaques, which are separated by the greatest width of a plaque, are of some aid in assigning specimens to this species. The aedeagus must be used to reliably distinguish males of this species from others in the *marginicollis* Subgroup which are of approximately the same body size and plaque configuration.

Description. – *Form:* Elongate. *Size:* Holotype 1.28 mm long, 0.52 mm wide. *Color:* Head with dorsal surface dark brown, nearly black; labrum dark brown; maxillary palpi brown; antennae brown. Pronotum dark brown, nearly black, except for narrow, testaceous border at anterior and posterior margins. Elytra brown. Ventral surface dark brown except legs, elytral epipleura, apex of abdomen and inflexed margin of pronotum brown. *Head:* Length 0.20 mm. Width 0.34 mm. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely microreticulate at sides, shining in midline. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively; 0.20/0.08/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral suface nearly straight, median surface rather markedly arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface shining, finely and sparsely punctulate. Submentum microreticulate. Genae shining: lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with fine, contiguous punctation. Last five antennomeres pubescent. Eyes slightly less than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.34 mm; maximum width (at anterior 0.33 mm) 0.44 mm; sides margined, denticulate; sides relatively weakly produced at anterior 0.33, slightly arcuate and slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.38 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.42 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola absent. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola absent. Disc shining, punctures fine, separated by puncture diameter; most punctures with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered; apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with plaques well developed, triangular; plaques 0.33 length of metasternum in midline; width of each plaque subequal to width of intercoxal process at its apex; plaques separated posteriorly by approximately plaque width; plaques flat in cross section. *Elytra:* Length 0.84 mm. Maximum width (at midlength) 0.52 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.50 puncture diameter, as are interstices between adjacent punctures of a row; each puncture with seta. Explanate margin quite narrow, ended near posterior 0.20, with fine, well separated serrations in apical 0.33; serrations closer near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, longer than wide, posterior margin straight. Glabrous segments at apex moderately produced. Segment 7 emarginate at apex. *Legs:* Protibia arcuate. *Genitalia:* Aedeagus as illustrated (Fig. 51B)(1 examined).

Distribution. – (Fig. 170). Presently known only from Haiti.

Etymology. – Latin, *haitensis*, in reference to the known geographical distribution.

68. *Hydraena mexicana* new species
(Figs. 42A,51C,170)

Type-locality. – Four miles N. Bochil, Chiapas, Mexico.

Type-specimens. – The holotype male is deposited in USNM. My wife Maureen and I collected this specimen, May 28, 1974. The allotype, collected by Hugh B. Leech, is deposited

with the holotype and has the following data: Clear stream at Palitla, 5 mi. N. of Tamazunchale, 22-XII-1948, San Lusi Potosi, Mexico. Paratypes (5) are listed in the appendix.

Diagnosis. – The plaques are elongate, parallel, separated from one another by two-three times the width of a plaque. The aedeagus must be studied to reliably discriminate males of *Hydraena mexicana* from others in the *marginicollis* Subgroup with similar plaque configuration.

Description. – *Form:* Elongate. *Size:* Holotype 1.42 mm long, 0.58 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum with subquadrate, dark brown macula; lateral areas testaceous. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.18 mm. Width 0.34 mm. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely punctulate. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.24/0.14/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface very slightly arcuate, median surface moderately arcuate; palpomere 4 widest near midlength. Mentum length equal width, surface markedly shining, punctures fine and sparse. Submentum punctation similar to mentum. Genae moderately elevated, shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with punctation much finer and closer than that of submentum. Last five antennomeres pubescent. Eyes slightly greater than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (at approximately midlength) 0.44 mm; sides margined, denticulate; sides relatively slightly produced at middle, slightly arcuate and slightly convergent to anterior angle, slightly sinuate and slightly convergent to posterior; anterior border 0.38 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.40 mm wide,slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression slightly developed. Area between external foveolae weakly elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola slightly developed, with punctures closer together than punctures on disc. Disc shining, punctures fine, separated by one-two times puncture diameter; most punctures with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process moderately broad, sides tapered, apex blunt, width at apex slightly greater than 0.50 distance between internal and median carinae. Metasternum with plaques moderately developed, straight, parallel; plaques 0.40 length of metasternum in midline; width of each plaque subequal to width of intercoxal process at its apex; plaques separated posteriorly by approximately twice plaque width; plaques on side of median depression, sloped very slightly toward midline. *Elytra:* Length 0.86 mm. Maximum width (at midlength) 0.58 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to nearly twice puncture diameter, as are interstices between adjacent punctures of a row; punctures each with seta. Explanate margin quite narrow, ended near posterior 0.12, with prominent serrations in posterior 0.33; serrations smaller near apices. Elytral apices, in dorsal aspect, weakly truncate; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle, posterior margin straight. Glabrous segments at apex moderately produced. Tergum 7 emarginate at apex; sternum with small, circular excavation on inner surface. *Legs:* Protibia with inner surface straight, lateral surface slightly arucate. Metatibia markedly enlarged in basal 0.17, gradually enlarged for remainder of length. *Genitalia:* Aedeagus as illustrated (Fig. 51C)(5 examined).

Natural History. – Refer to *H. splecoma* .

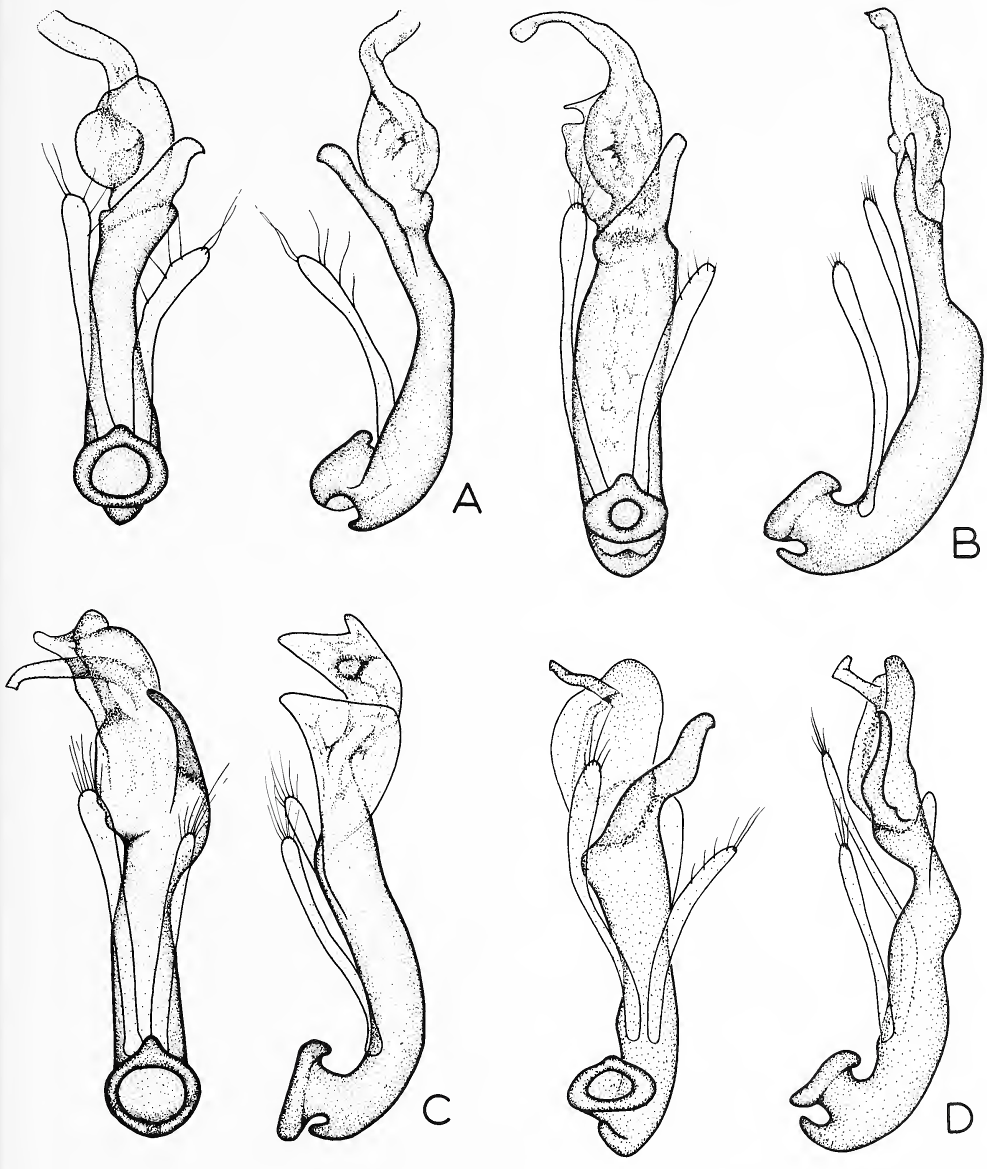
Distribution. – (Figs. 42A,170). Presently known from the Mexican states of San Luis Potosi, Veracruz and Chiapas.

Etymology. – Adjective, Latin form, *mexicana*, in reference to the geographical distribution.

69. *Hydraena perkinsi* Spangler
(Figs. 51D,170)

Hydraena perkinsi Spangler, 1980:331 (holotype male in USNM; type-locality: Quenado de Pineda, Cuba).

Diagnosis. – Adults are moderately large, about 1.48 mm long, with plaques subtriangular in shape. The aedeagus must be used to differentiate *Hydraena perkinsi* males from those of other members of the *marginicollis* Subgroup of similar body size and plaque configuration.



Figs. 51A – D, Aedeagi of *Hydraena* holotypes. (A) *H. guatemala*. (B) *H. haitensis*. (C) *H. mexicana*. (D) *H. perkinsi*.

Description. – *Form:* Elongate. *Size:* Holotype 1.48 mm long, 0.64 mm wide. *Color:* Head with dorsum black, venter dark brown, palpi and antennae testaceous. Pronotum with anterior and posterior 0.25 testaceous, middle 0.50 with black macula, macula lighter near sides. Elytra brown. Venter dark brown. Legs, inflexed margin of pronotum and elytral epipleura testaceous. *Head:* Length 0.22 mm, width 0.36 mm. Frons moderately densely, moderately coarsely punctate, most punctures separated by less than puncture diameter. Frontoclypeal suture slightly arcuate. Clypeus shiny, very finely punctulate in middle, microreticulate laterally. Labroclypeal suture straight. Labrum microreticulate, bilobed, median emargination ended near midlength. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4 respectively: 0.26/0.12/0.18; palpomere 4 asymmetrical, widest near distal 0.33. Mentum width equal length, punctulate, microreticulate. Submentum microreticulate. Genae shiny, foveolate laterally. Postgena microreticulate. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (slightly before midlength) 0.48 mm; sides margined, finely denticulate, very slightly produced, straight and slightly convergent to anterior angles, slightly sinuate and slightly convergent to posterior angles; anterior border 0.40 mm wide, straight and nearly perpendicular to midline in lateral 0.20, slightly arcuate in middle 0.60; posterior border very slightly arcuate to rear. Posterointernal and posteroexternal foveolae absent. Anteroexternal foveolae well developed, each extended across 0.25 width of anterior region of pronotum. Disc shiny, moderately densely, moderately coarsely punctate, most punctures separated by less than puncture diameter; punctures without apparent seta. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin median carina, latter sinuate in lateral view. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with plaques well developed, flat, 0.50 length of metasternum, median margins parallel, lateral margins slightly convergent anteriorly; each plaque tapered from posterior to anterior, width at base subequal width of intercoxal process; plaques separated at base by twice plaque width. *Elytra:* Length 0.94 mm; Maximum width (at midlength) 0.64 mm. Disc shiny, with 10 rows of moderately large punctures between suture and humeral callus; intervals not elevated, width subequal puncture diameter, interstices between punctures of row slightly less. Explanate margin slightly developed, ended near posterior 0.20, border finely serrate in posterior 0.33. Elytral apices slightly dehiscent in dorsal view; viewed posteriorly, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle; posterior margin straight. Glabrous segments at apex produced. Tergum 7 emarginate at apex. *Legs:* Protibia slightly expanded and with two rows of short spines in distal 0.33. Other legs slender, unmodified. *Genitalia:* Aedeagus as illustrated (Fig. 51D)(1 examined).

Variation. – Females lack the protibial modifications seen in males.

Distribution. – (Fig. 170). Cuba.

The *jivaro* Complex

70. *Hydraena grouvellei* d'Orchymont
(Figs. 52A,171B)

Hydraena grouvellei d'Orchymont, 1923:35 (holotype depository uncertain; type-locality: "Mexique (tabacs)").

According to d'Orchymont (1923) the holotype is in the Paris Museum. Through the courtesy of that institution I have been able to study a male paratype. There is a possibility that further search will reveal the holotype, therefore I am not designating a lectotype at this time.

Diagnosis. – Distinguished from other members of the *marginicollis* Subgroup by the extremely shiny dorsum and the arcuate, carinate plaques. The punctures on the pronotum are very fine and widely spaced, interstices being three-six times puncture diameter. The elytra are truncate in males (I have not seen females).

Description. – *Form:* Elongate-oval. *Size:* The paratype male I have studied is 1.43 mm long, 0.64 mm wide. *Color:* Head with dorsal surface dark brown, black near eyes; labrum brown; maxillary palpi and antennae testaceous. Pronotum dark brown except narrow testaceous anterior and posterior border. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum, light brown. *Head:* Length 0.19 mm. Width 0.36 mm. Frons finely and sparsely punctate, interstices two-four times puncture diameter; surface shining. Frontoclypeal suture slightly arcuate to rear. Clypeus finely microreticulate at sides, impunctate and shining in midline. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively:

0.28/0.12/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface straight, median surface arcuate; palpomere 4 widest at anterior 0.33. Mentum wider than long, surface shining, finely punctulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena microreticulate. Last five antennomeres pubescent. Eyes 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.42 mm; maximum width (at approximately midlength) 0.52 mm; sides margined, not denticulate in anterior 0.50, extremely finely denticulate in posterior 0.50; sides relatively slightly produced at middle, very slightly arcuate and slightly convergent to anterior angle, very slightly arcuate and slightly convergent to posterior; anterior border 0.44 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.50 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola absent. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.20 width of anterior region of pronotum. Transverse foveola absent. Disc brilliantly shining, punctures extremely fine, separated by three-six times puncture diameter; punctures without distinctive setae extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered, apex blunt, width at apex 0.50 distance separating internal and median carinae. Metasternum with plaques well developed, carinate, markedly arcuate, 0.50 length of metasternum in midline; plaques separated posteriorly by approximately six times plaque width. *Elytra:* Length 0.93 mm. Maximum width (at midlength) 0.64 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to twice puncture diameter, as are interstices between adjacent punctures of a row; punctures without perceptible setae. Explanate margin moderately developed, ended near posterior 0.10, with extremely fine, well separated serrations along anterior 0.66, quite large and distinct in posterior 0.33; serrations obsolete near apices. Elytral apices, in dorsal aspect, truncate; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly an equilateral triangle, posterior margin straight. Glabrous segments at apex well produced. Tergum 7 emarginate at apex; sternum with oval excavation on inner surface in midline. *Legs:* Profemur with minute tubercle on inner surface near midlength. Protibia excavate on inner surface near apex. Metatibia enlarged gradually from base to apex. *Genitalia:* Aedeagus as illustrated (Fig. 52A)(2 examined).

Distribution. – (Fig. 171B). Exact location within Mexico uncertain. The single specimen I have seen in addition to the paratype described above is also labelled "Mexique, tabacs", which is the only information given by d'Orchymont (1923) in the original description.

71. *Hydraena premordica* new species
(Figs. 50B,52B,171B)

Type-locality. – Mayaro, Trinidad.

Type-specimens. – The holotype male is deposited in MCZ. This specimen was collected by P. J. Darlington, April 28, 1929. The allotype, which is deposited in BMNH, has the following data: British Guiana, Kanuku Mts., Rupununi, 61-2-21, T. Clay. Paratypes (24) have the same data as the allotype and are deposited in BMNH, USNM and PDP.

Diagnosis. – Males are instantly recognized by the markedly truncate elytra; each elytron has the posterior margin sinuate. Both sexes have a few punctures on the elytral disc random, not in serial rows as are the remaining punctures. The elytra of females are slightly angulate on the sides in the posterior, but the apices are not truncate. Plaques are well developed, non-carinate.

Description. – *Form:* Elongate-oval. *Size:* Holotype 1.76 mm long, 0.76 mm wide. *Color:* Head with dorsal surface brown, dark brown near eyes; labrum brown; antennae testaceous. Pronotum testaceous at anterior and posterior 0.20, dark brown in middle 0.60. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.20 mm. Width 0.42 mm. Frons moderately punctured, interstices generally less than puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely punctulate. Labroclypeal suture straight in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpi missing from specimen. Mentum wider than long, surface moderately shining, microreticulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation similar to that of submentum. Last five

antennomeres pubescent. Eyes slightly less than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.46 mm; maximum width (at approximately midlength) 0.58 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and convergent to anterior angle, slightly sinuate and convergent to posterior; anterior border 0.44 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.52 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola absent. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area closer together than punctures on disc. Disc moderately shining, punctures fine, separated by thin walls near anterior and posterior borders, by puncture diameter in middle; most punctures with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel, apex blunt, width at apex 0.33 distance between internal and median carinae. Metasternum with plaques well developed, straight, convergent moderately from posterior to anterior; plaques 0.50 length of metasternum in midline; width of each plaque subequal to width of intercoxal process at its apex; plaques separated posteriorly by approximately twice plaque width; plaques flat in cross section. *Elytra:* Length 1.04 mm. Maximum width (at midlength) 0.76 mm. Surface shining, anterior 0.66 with random punctures gradually arranged into rows in posterior 0.33 of elytra; most punctures round; interstices generally less than puncture diameter; most punctures with seta. Explanate margin quite narrow, ended at apices, with extremely fine, well separated serrations along entire margin. Elytral apices, in dorsal aspect, truncate, apex of each elytron sinuate line; in posterior aspect, elytral margins together in form of a half oval. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex moderately produced. Tergum 7 emarginate at apex; sternum with oval excavation on inner surface in midline. *Legs:* Profemur with oblique carina on inner surface near basal 0.33. Protibia weakly arcuate; posterior surface with prominent, tooth-like expansion at apical 0.33. Metafemur relatively narrow. Metatibia thin, parallel sided. *Genitalia:* Aedeagus as illustrated (Fig. 52B)(2 examined).

Natural History. – Specimens from the Kanuku Mountains of Guyana have the label notation: "debris edge of forest creek".

Distribution. – (Figs. 50B,171B). Presently known from Trinidad and Guyana.

Etymology. – Latin, *premordica* (bitten off at the end). This name refers to the truncate elytra of males.

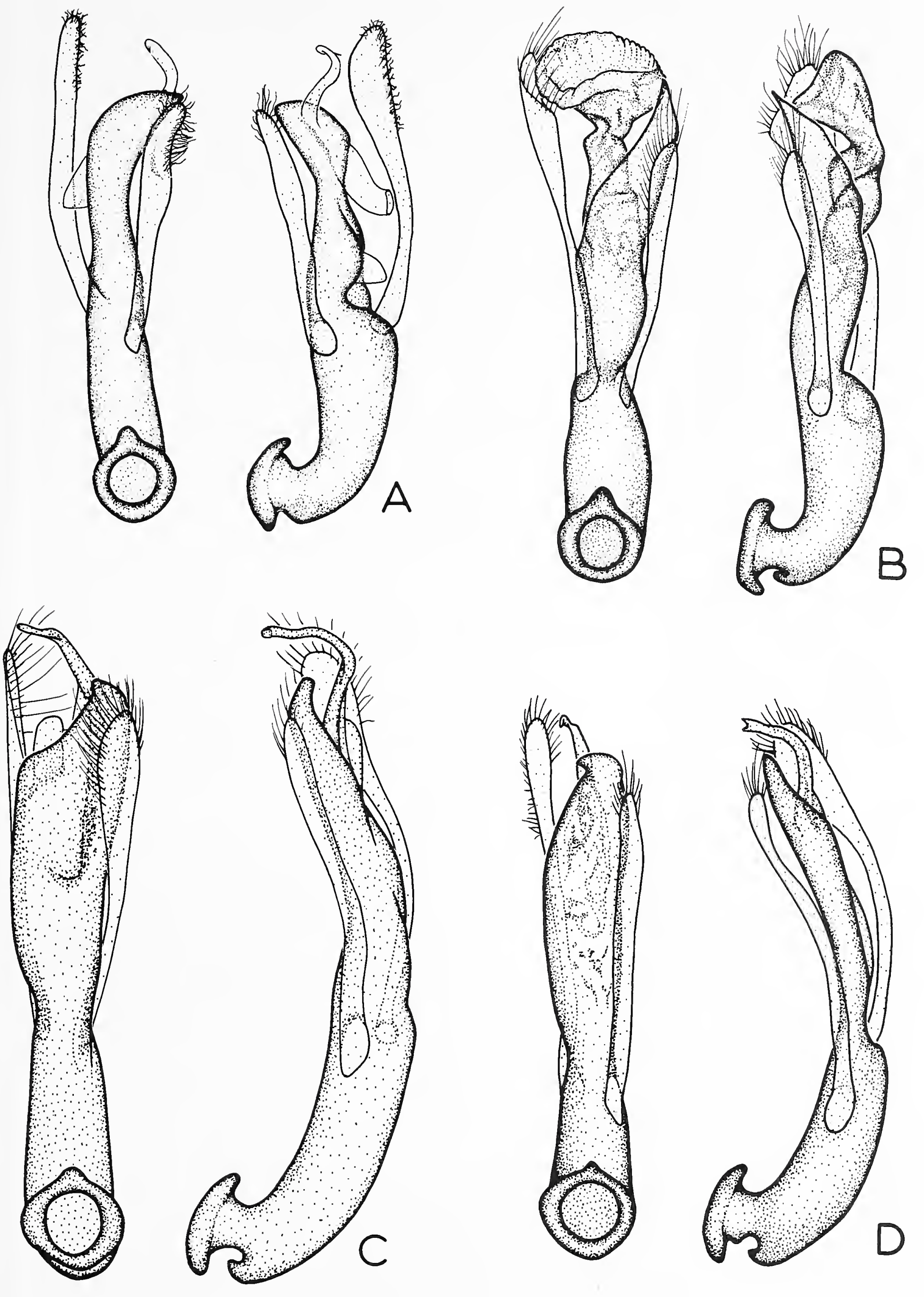
72. *Hydraena jivaro* new species (Figs. 50B,52C,171B)

Type-locality. – 3 kilometers S. Tena, Napo Province, Ecuador.

Type-specimens. – The holotype male, allotype and one female paratype are deposited in USNM. These specimens were collected by P. J. Spangler and D. R. Givens, May 13, 1977.

Diagnosis. – Readily distinguished from *Hydraena quechua* adults, the only other *Hydraena* now known from Ecuador, by larger size (1.48 vs 1.22 mm) and testaceous labrum. The labrum of *Hydraena quechua* adults is black. Separation from other similarly sized and sculptured members of the *marginicollis* Subgroup, however, must be based on the aedeagus.

Description. – *Form:* Elongate. *Size:* Holotype 1.48 mm long, 0.64 mm wide. *Color:* Dorsum with labrum testaceous; clypeus brown in middle, testaceous laterally; frons black; pronotum with transverse black macula extended from anterior 0.28 to posterior 0.14, remainder testaceous; elytra brown. Venter dark brown. Legs with basal 0.50 of femur brown, remainder testaceous. Maxillae testaceous. *Head:* Length 0.22 mm; width 0.36 mm. Frons moderately punctate, most punctures separated by puncture diameter, interstices shining. Frontoclypeal suture slightly arcuate. Clypeus shiny in midline, microreticulate and dull laterally. Labroclypeal suture straight. Labrum bilobed, median emargination ended at midlength, microreticulate. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4 respectively: 0.27/0.10/0.18; palpomere 4 asymmetrical, greatest width near apical 0.33. Mentum width equal length, shiny, finely punctulate. Submentum microreticulate. Genae shiny, foveolate laterally; posterior ridge absent. Postgena microreticulate. *Thorax:* Pronotum length at midline 0.40 mm; Maximum width (at midlength) 0.50 mm; sides margined, denticulate, slightly produced at middle, slightly arcuate and slightly convergent to anterior angles, very slightly sinuate and slightly convergent to posterior angles; anterior border 0.40 mm wide, straight and nearly perpendicular to midline in lateral 0.17, moderately arcuate to rear in middle 0.66; posterior border 0.46 mm wide, very slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveolae extremely shallow, nearly imperceptible. Interfoveolar depression shallow. Anteroexternal foveolae well developed, each somewhat crescent shaped, extended about 0.25 width of anterior region of



Figs. 52A – D, Aedeagi of *Hydraena* species. (A) *H. grouvellei*, paratype. (B) *H. premordica*, holotype. (C) *H. jivaro*, holotype. (D) *H. anaphora*, holotype.

pronotum. Transverse foveola absent. Disc shiny, punctures slightly elongate, separated by thin walls near anterior and posterior borders, by two-three times puncture width in middle; punctures without apparent setae. Scintilla absent. Prosternum carinate; coxae separated by thin median carina, latter sinuate in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with well developed parallel plaques, separated by twice plaque width, 0.50 length of metasternum; each plaque about as wide as apex of intercoxal process. *Elytra:* Length 0.96 mm; maximum width (at midlength) 0.64 mm. . Disc shiny, with 10 rows of moderate sized punctures between suture and humeral callus; intervals not elevated, width slightly less than puncture width, as are interstices between punctures of a row; punctures with very fine seta. Explanate margin moderately developed, ended near posterior 0.20. Elytral border from posterior 0.20 to apices finely serrate. Elytral apices nearly truncate in dorsal view; viewed posteriorly, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly equilateral triangle, posterior margin straight. Glabrous segments at apex produced. Tergum 7 emarginate at apex. *Legs:* Profemur with small carina on inner surface near basal 0.33. Protibia excavate on inner surface from basal 0.25 to apex, small tooth at base of excavation. Other legs apparently unmodified. *Genitalia:* Aedeagus as illustrated (Figure 52C) (1 examined).

Distribution. – (Figs. 50B,171B). Known only from the typelocality near Tena in Napo Province of Ecuador.

Etymology. – Noun in apposition, Latin in form, *jivaro*, in reference to the Jivaro Indians of Ecuador.

73. *Hydraena anaphora* new species
(Figs. 52D,171B)

Type-locality. – Cuyaba, Matto Grosso, Brazil.

Type-specimen. – The holotype male (unique) is deposited in CMP. The collector and date are unknown.

Diagnosis. – The arcuate plaques which are elevated in the anterior, plus non-modified metatibiae of males serve to distinguish *H. anaphora* adults from other members of the *marginicollis* Subgroup. Plaques are widest at their bases, about as wide as the mesosternal process; three times this distance separates the plaques at their bases. Each plaque narrows anteriorly to form an elevated,subcariniform prominence.

Description. – *Form:* Elongate. *Size:* Holotype 1.60 mm long, 0.64 mm wide. *Color:* Head with dorsal surface dark brown, nearly black adjacent to eyes; labrum testaceous; maxillary palpi brown; antennae testaceous. Pronotum testaceous at anterior and posterior 0.20, dark brown in middle 0.60; sides slightly lighter than disc. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.20 mm. Width 0.36 mm. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely punctulate. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended slightly above midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.26/ 0.12/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, arcuate in apical 0.66, median surface more markedly arcuate; tarsomere 4 widest slightly past midlength. Mentum wider than long, surface moderately shining, finely and sparsely punctulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly greater than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (at approximately midlength) 0.48 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and slightly convergent to anterior angle, sinuate and convergent to posterior; anterior border 0.40 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.44 mm. wide, slightly arcuate to rear. Posterointernal foveolae absent. Interfoveolar depression moderately developed. Posteroexternal foveolae absent. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended across slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc shining, punctures fine, separated by one-three times puncture diameter; most punctures without distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel in apical 0.50, apex blunt, width at apex 0.33

distance between internal and median carinae. Metasternum with plaques well developed, slightly arcuate, convergent from posterior to anterior; plaques 0.50 length of metasternum in midline; greatest width of each plaque subequal to width of intercoxal process at its apex; plaques separated posteriorly by approximately three times plaque width; each plaque narrowed to thin elevated, subcariniform prominence at anterior. *Elytra:* Length 0.96 mm. Maximum width (at midlength) 0.64 mm. surface shining, disc with 10 rows of punctures between suture and humeral callus, rows somewhat irregular; most punctures round; intervals not elevated, width approximately equal to puncture diameter, as are interstices between adjacent punctures of row; each puncture with seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine, well separated serrations along entire margin; serrations somewhat closer near apices. Elytral apices, in dorsal aspect, truncate; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex moderately produced. Tergum 7 emarginate at apex; sternum with a round excavation on inner surface in midline. *Legs:* Profemur with oblique, cariniform protuberance on inner surface near basal 0.33. Protibia very slightly arcuate; inner surface expanded in apical 0.33. Metafemur broad; anterior surface markedly arcuate; posterior sinuate. Metatibia slender, nearly parallel sided in apical 0.66. *Genitalia:* Aedeagus as illustrated (Fig. 52D) (1 examined).

Distribution. – (Fig. 171B). Presently known only from the type-locality in Matto Grosso, Brazil.

Etymology. – Latin, *anaphora* (a rising). Named in reference to the raised anterior region of the plaques.

74. *Hydraena hyalina* new species
(Figs. 64A,92A,171B)

Type-locality. – 32 km. SW Calabozo, Guarico, Venezuela.

Type-specimens. – The holotype male is deposited in USNM. The allotype, also deposited in USNM, has the following data: 15 km. S. Calabozo, Guarico, Venezuela. These specimens were collected by Paul and Phyllis Spangler, February 9-11, 1969. Paratypes (70) are listed in the appendix.

Diagnosis. – This species cannot be adequately characterized on the basis of external features at this time. The aedeagus must be studied to reliably distinguish males of *Hydraena hyalina* from others in the *marginicollis* Subgroup. The pronotum is relatively coarsely punctate and has very shallow posterointernal foveolae, which would indicate that this species should be placed in the *leechi* Group. The aedeagus, however, appears to be most similar to males of the *marginicollis* Group, hence its placement here.

Description. – *Form:* Elongate. *Size:* Holotype 1.44 mm long, 0.56 mm wide. *Color:* Head with dorsum and labrum black; maxillary palpi and antennae testaceous. Pronotum testaceous at anterior and posterior 0.25, black in middle 0.50; black of disc blending into brown at sides. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.20 mm. Width 0.36 mm. Frons moderately punctured, interstices equal to or slightly less than puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely punctulate. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.20/0.08/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface weakly arcuate, median surface more markedly arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface shining, moderately and sparsely punctulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation similar to that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.32 mm; maximum width (at approximately midlength) 0.46 mm; sides margined, denticulate; sides relatively slightly produced at middle, slightly arcuate and slightly convergent to anterior angle, very slightly sinuate and slightly convergent to posterior; anterior border 0.40 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.44 mm wide, slightly arcuate to rear. Posterointernal foveolae very shallow. Posteroexternal foveola absent. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended slightly less than 0.33 width of anterior region of pronotum. Transverse foveola slightly developed, punctures separated by thin walls. Disc moderately shining, punctures fine, close and rather deeply impressed, separated by 0.50 puncture diameter near anterior and posterior borders, by puncture diameter in middle; most punctures with seta extended above cuticle in dry specimens.

Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered; apex rounded, width near apex 0.33 distance between internal and median carinae. Metasternum with plaques moderately developed, straight, convergent very slightly from posterior to anterior; plaques 0.43 length of metasternum in midline; width of each plaque subequal to width of intercoxal process at its midlength; plaques separated posteriorly by approximately twice plaque width; plaques flat in cross section. *Elytra:* Length 0.88 mm. Maximum width (at midlength) 0.56 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.50 puncture diameter, as are interstices between adjacent punctures of a row; each puncture with seta. Explanate margin quite narrow, ending near posterior 0.20, with extremely fine, well separated serrations along entire margin; serrations somewhat closer near apices. Elytral apices, in dorsal aspect, almost truncate; viewed posteriorly, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly equilateral triangle, posterior margin straight. Glabrous segments at apex well produced. Tergum 7 emarginate at apex; sternum with round excavation on inner surface in midline. *Legs:* Protibiae rather markedly arcuate. Metatibia gradually enlarged to apex. *Genitalia:* Aedeagus as illustrated (Fig. 64A)(37 examined).

Distribution. – (Figs. 92A,171B). Presently known from southeastern Brazil, Guyana, and Venezuela.

Etymology. – Latin, *hyalina* (glassy, transparent). This name refers to the major process of the aedeagus.

The *trinidensis* Complex

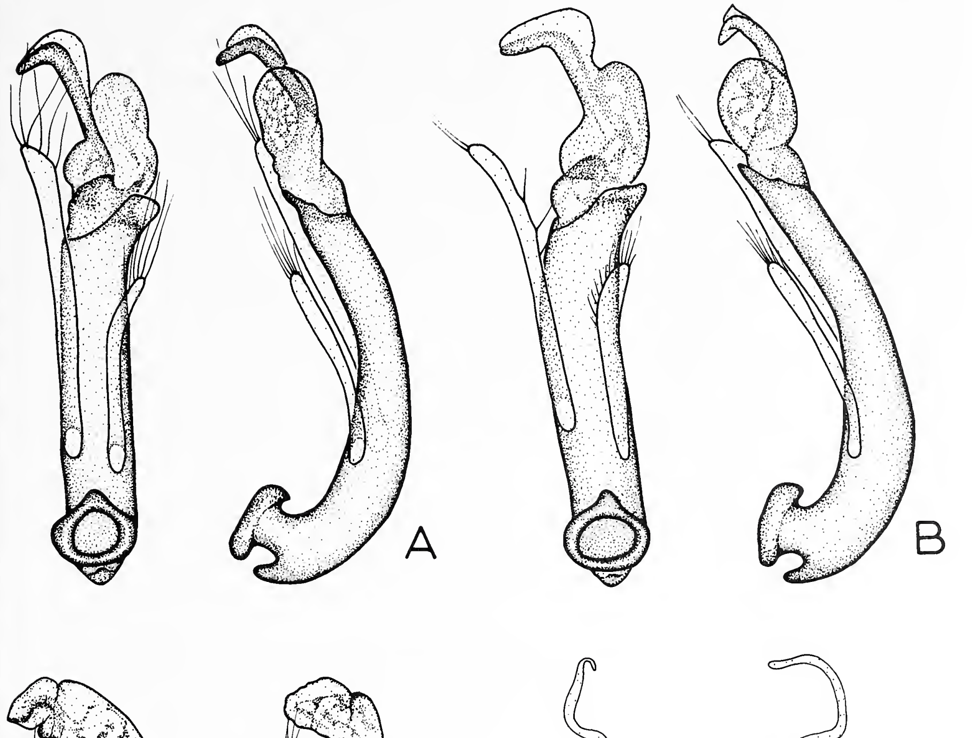
75. *Hydraena browni* new species
(Figs. 53A-B,92A,172A)

Type-locality. – San Fernando, Guarico, Venezuela.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. One male and one female paratype, same data as holotype, are also deposited in USNM. Paul and Phyllis Spangler collected these specimens, February 12, 1969. One male and two female paratypes (PDP) are from Pará, Brazil.

Diagnosis. – The aedeagus must be used to reliably differentiate *H. browni* males from other members of the *marginicollis* Subgroup of similar size, about 1.16 mm, and with plaques elongate, separated by three times plaque width.

Description. – *Form:* Elongate. *Size:* Holotype 1.16 mm long, 0.50 mm wide. *Color:* Head with dorsal surface black, with vague purple reflections; labrum black; maxillary palpi testaceous; antennae testaceous. Pronotum testaceous at anterior and posterior 0.25, black in middle 0.50; black blending into brown at sides. Elytra brown. Ventral surface dark brown except legs, elytra epipleura and inflexed margin of pronotum brown. *Head:* Length 0.18 mm. Width 0.32 mm. Frons finely and sparsely punctured, interstices twice puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely punctulate. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.20/0.08/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface slightly arcuate, median surface more markedly arcuate. Mentum wider than long, surface shining, finely and sparsely punctulate. Submentum sparsely, finely punctulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with punctation slightly smaller than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.30 mm; maximum width (at approximately midlength) 0.42 mm; sides margined, denticulate; sides relatively slightly produced at middle, slightly arcuate and slightly convergent to anterior angle, very slightly sinuate and slightly convergent to posterior; anterior border 0.36 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.38 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola absent. Anteroexternal foveolae well developed, each foveola somewhat cresent shaped, extended slightly less than 0.33 width of anterior region of



Figs. 53A – D, Aedeagi of *Hydraena* species. (A) *H. browni*, holotype. (B) *H. browni* variant from Para, Brazil. (C) *H. trinidensis*, holotype. (D) *H. insularis*, holotype.

pronotum. Transverse foveola absent. Disc shining, punctures fine, separated by one-three times puncture diameter; most punctures with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered, apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with plaques moderately developed, straight, convergent moderately from posterior to anterior; plaques 0.57 length of metasternum in midline; width of each plaque subequal to width of intercoxal process at its apex; plaques separated posteriorly by approximately three times plaque width; plaques flat in cross section. *Elytra:* Length 0.76 mm. Maximum width (at midlength) 0.50 mm. surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.50 puncture diameter, as are interstices between adjacent punctures of a row; each puncture with a seta. Explanate margin quite narrow, ending near posterior 0.20, with extremely fine serrations in posterior 0.33. Elytral apices, viewed from above, truncate; in posterior aspect, elytral margin rises obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly equilateral triangle, posterior margin straight. Glabrous segments at apex moderately produced, directed ventrad. Tergum 7 emarginate at apex; sternum with oval excavation on inner surface at apex. *Legs:* Protibia excavate on inner surface at apex. Metafemur gradually enlarged from base to apex. *Genitalia:* Aedeagus as illustrated (Figs. 53A-B)(16 examined).

Variation. – I have illustrated the aedeagus of a male from Pará, Brazil (Fig. 53B), which differs slightly from specimens from Venezuela. Externally, specimens from the two areas compare very well.

Distribution. – (Figs. 92A,172A). Presently known from San Fernando, Venezuela, which is in the Orinoco drainage system, and Pará (Belém), Brazil, at the mouth of the Amazon River.

Etymology. – I am pleased to dedicate this species to Harley P. Brown in recognition of his contributions to this study and to the study of aquatic Coleoptera in general.

76. *Hydraena trinidensis* new species
(Figs. 53C,172A)

Type-locality. – St. Augustine, Trinidad.

Type-specimens. – The holotype male is deposited in MCZ. The allotype and four female paratypes from Mayaro, Trinidad, are also deposited in MCZ. These specimens were collected by P. J. Darlington, April, 1929.

Diagnosis. – Difficult to differentiate from other members of the *marginicollis* Subgroup which are about the same size (1.34 mm) and have the plaques moderately developed. The aedeagus (Fig. 53C) must be studied to reliably assign males to this species.

Description. – *Form:* Elongate. *Size:* Holotype 1.34 mm long, 0.56 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum testaceous at anterior and posterior 0.25, dark brown in middle 0.50; sides slightly lighter than middle. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum testaceous. *Head:* Length 0.18 mm; width 0.34 mm. Frons moderately punctured, interstices one-two times puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely microreticulate at sides, shining in midline. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ending at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.24/0.08/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface slightly arcuate, median surface rather markedly arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface shining, finely and sparsely punctulate. Submentum finely punctulate, many punctures contiguous. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena microreticulate. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (at approximately midlength) 0.44 mm; sides margined, denticulate; sides relatively slightly produced at middle, slightly arcuate and slightly convergent to anterior angle, very slightly sinuate and slightly convergent to posterior; anterior border 0.38 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.40 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola absent. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc shining, punctures fine, separated by one-three times puncture

diameter; most punctures with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel; apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with plaques moderately developed, triangular, convergent moderately from posterior to anterior; plaques 0.43 length of metasternum in midline; greatest width of each plaque subequal to width of intercoxal process at its apex; plaques separated posteriorly by approximately twice plaque width; plaques on sides of median depression, sloped slightly toward midline. *Elytra:* Length 0.84 mm. Maximum width (at midlength) 0.56 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to puncture diameter, as are interstices between adjacent punctures of a row; most punctures with a seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine, well separated serrations in apical 0.33. Elytral apices, in dorsal aspect, almost truncate; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, longer than wide, posterior margin straight. Glabrous segments at apex moderately produced. Tergum 7 emarginate at apex; sternum with oval excavation on inner surface in midline. *Legs:* Protibia slightly arcuate, excavate on inner surface near apex. *Genitalia:* Aedeagus as illustrated (Fig. 53C)(1 examined).

Distribution. – (Fig. 172A). Presently known only from the island of Trinidad.

Etymology. – Latin adjective, *trinidensis*, in reference to the geographical distribution.

77. *Hydraena insularis* d'Orchymont
(Figs. 53D,172A)

Hydraena insularis d'Orchymont, 1945a:2 (holotype depository uncertain; type-locality: Guadeloupe).

Through the courtesy of the Institut Royal des Sciences Naturelles de Belgique, Brussels, I have studied a male paratype of *H. insularis*. I am of the opinion that additional search may reveal the holotype; therefore a lectotype is not designated herein.

Diagnosis. – Plaques of adults are well developed, triangular, separated at their bases by about twice the greatest width of a plaque. Positive identifications of males must be based upon the aedeagal form (Fig. 53D).

Description. – *Form:* Elongate. *Size:* Paratype 1.54 mm long, 0.68 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum testaceous at anterior and posterior 0.25, dark brown in middle 0.50. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.22 mm. Width 0.38 mm. Frons finely and sparsely punctured, interstices one-three times puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely microreticulate at sides, shining in midline. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively; 0.28/0.12/0.18; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight, median surface arcuate, widest slightly past midlength. Mentum wider than long, surface moderately shining, punctures fine, separated by puncture diameter. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with punctation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (at approximately midlength) 0.50 mm; sides margined, denticulate; sides relatively slightly produced at middle, slightly arcuate and slightly convergent to anterior angle, slightly sinuate and slightly convergent to posterior; anterior border 0.42 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.46 mm wide, slightly arcuate to rear. Posterointernal and posteroexternal foveolae absent. Transverse foveola not developed, punctures in this area closer together than punctures on disc. Disc shining, punctures fine, separated by puncture diameter near anterior and posterior borders, and by two-three times puncture diameter in middle; punctures without distinctive setae extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as short spine; coxae separated by thin, median carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad, sides nearly parallel, apex blunt, width at apex nearly 0.66 distance separating internal and median carinae. Metasternum with plaques well developed, triangular, straight; plaques 0.50 length of metasternum in midline; greatest width of each plaque slightly greater than width of intercoxal process at its midlength; plaques separated posteriorly by approximately twice plaque width; each plaque tapered from posterior to anterior; plaques on sides of median depression, sloped slightly toward midline. *Elytra:* Length 1.00 mm. Maximum width (at midlength) 0.68 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite

regular; most punctures round; intervals not elevated, width slightly greater than puncture diameter, as are interstices between adjacent punctures of row; punctures without perceptible setae. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine, well separated serrations along entire margin; serrations somewhat closer near apices. Elytral apices, in dorsal aspect, nearly truncate; in posterior aspect, elytral margin extended obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly equilateral triangle, posterior margin straight. Glabrous segments at apex moderately produced. Tergum 7 emarginate at apex; sternum with oval excavation on inner surface to left of midline. *Legs:* Protibiae with a very small excavation on inner surface at apex. Metatibiae gradually enlarging from base to apex. *Genitalia:* Aedeagus as illustrated (Fig. 53D)(2 examined).

Distribution. – (Fig. 172A). Presently known from Guadeloupe and Dominica (1 specimen from the latter; see appendix).

Remarks. – The aedeagus I have illustrated from a paratype agrees well with the partial illustration presented by d'Orchymont (1945). The aedeagus appears flattened because it had been mounted on a microslide by a previous worker.

The *marginicollis* Complex

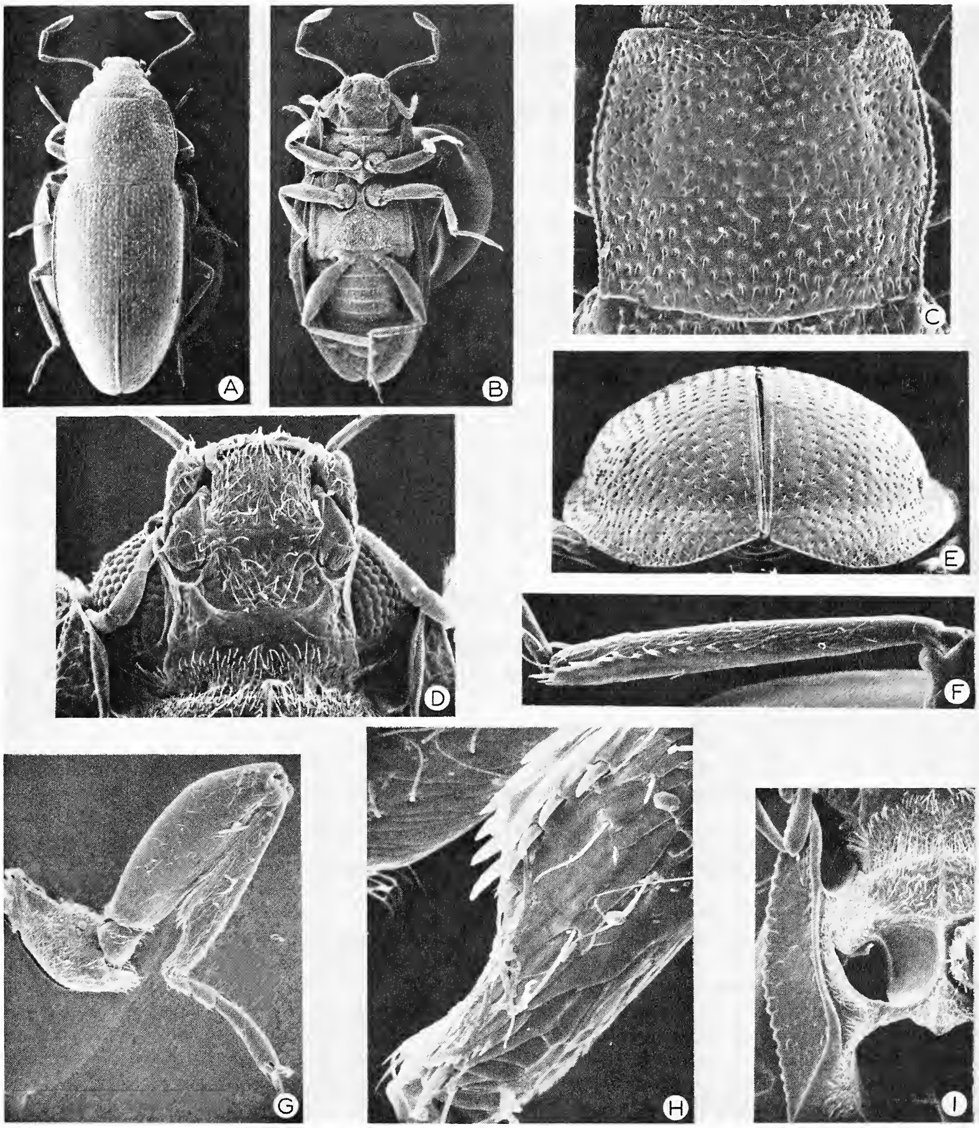
78. *Hydraena marginicollis* Kiesenwetter (Figs. 54A-I,55A,56A,172B)

Hydraena marginicollis Kiesenwetter, 1849:177 (neotype deposited in USNM, herein designated; type-locality: three miles S. Sopchoppy, Wakulla County, Florida). – d'Orchymont, 1923:36. – d'Orchymont 1945:1. – Young, 1954:204.

Attempts to determine the location of the holotype of *H. marginicollis* have been unsuccessful. I believe that this specimen has been destroyed. To insure taxonomic stability a neotype is designated herein.

Diagnosis. – *H. marginicollis* is the only member of the *marginicollis* Group now known from eastern North America (Fig. 56A). *H. marginicollis* adults are distinguished from most members of the *marginicollis* Subgroup by the moderate body size, about 1.48 mm long, and absence of metasternal plaques; the aedeagus must be used to differentiate males of this species from others, such as *H. pulsatrix*, which also lack plaques.

Description. – *Form:* Elongate. *Size:* Neotype 1.48 mm long, 0.60 mm wide. *Color:* Head with dorsal surface dark brown, nearly black; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum testaceous at anterior and posterior 0.19, dark brown in middle 0.66; testaceous areas slightly larger at anterior and posterior angles; macula slightly lighter at sides of pronotum. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum testaceous. *Head:* Length 0.20 mm. Width 0.32 mm. Frons finely and sparsely punctured, interstices one-two times puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely punctulate. Labroclypeal suture arcuate when viewed from above. Labrum bilobed, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.24/0.12/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface straight, median surface arcuate; palpomere 4 widest near midlength. Mentum width equal length, surface shining, finely and sparsely punctulate. Submentum finely punctulate, surface somewhat irregular. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with punctation much closer than those of mentum, contiguous. Last five antennomeres pubescent. Eyes 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm. maximum width (at approximately midlength) 0.46 mm; sides margined, denticulate; sides relatively slightly produced at middle, slightly arcuate and slightly convergent to anterior angle, very slightly sinuate and slightly convergent to posterior; anterior border 0.40 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.42 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola absent. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended slightly less than 0.25 width of anterior region of pronotum. Transverse foveola absent. Disc shining, punctures fine, separated by puncture diameter near anterior and posterior borders, and by twice puncture diameter in middle; punctures without distinctive setae extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly into very short spine; coxae separated by thin, median carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior;



Figs. 54A – I, *Hydraena marginicollis*, ♂. (A) dorsal habitus. (B) ventral habitus. (C) pronotum. (D) head, ventral aspect. (E) elytra, posterior aspect. (F) metatibia. (G) prothoracic leg. (H) apex of protibia. (I) prosternum with leg removed.

median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel, apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with plaques absent. *Elytra:* Length 0.89 mm. Maximum width (at midlength) 0.60 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to puncture diameter, as are interstices between adjacent punctures of a row; most punctures with perceptible seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine, well separated serrations along entire margin; serrations somewhat closer near apices. Elytral apices, in dorsal aspect, almost truncate; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly equilateral triangle; anterior angle rounded; posterior margin straight. Glabrous segments at apex greatly produced. Tergum 7 emarginate at apex; sternum with oval excavation on inner surface to left of midline. *Legs:* Profemur with small tubercle on inner surface near midlength. Protibia excavate on inner surface near apex. Metatibia nearly parallel sided in apical 0.66. *Genitalia:* Aedeagus as illustrated (Fig. 55A)(60 examined).

Natural History. – *H. marginicollis* is primarily a lowland pond species (Fig. 194C). It is quite common in Florida, being collected in such areas as, "emergent vegetation at lake shore", "small pools adjacent to reservoir", "litter under water hyacinth at creek", and "debris, lake shore". There is also some indication that it may be slightly salt tolerant. I have examined 177 specimens (see appendix).

Distribution. – (Figs. 56A,172B). Eastern North America, primarily coastal, from New Jersey south to Louisiana.

79. *Hydraena turrialba* new species
(Figs. 55B,172B)

Type-locality. – Turrialba, Costa Rica.

Type-specimens. – The holotype male, allotype and one female paratype with same locality data are deposited in USNM. Paul J. Spangler collected these specimens, July 15, 1965.

Diagnosis. – Aedeagal form is the only reliable means of distinguishing males of *H. turrialba* from those of other species of the *marginicollis* Subgroup which have small, oval plaques and are of approximately the same body size (1.40 x 0.64 mm).

Description. – *Form:* Elongate. *Size:* Holotype 1.40 mm long, 0.64 mm wide. *Color:* Head with dorsal surface black except for brown area near eyes; labrum dark brown; maxillary palpi and antennae testaceous. Pronotum testaceous at anterior and posterior 0.25, black in middle 0.50; black blending into dark brown at sides. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.20 mm. Width 0.36 mm. Frons finely punctured, interstices one-three times puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely microreticulate at sides, shining in middle. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.24/0.10/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface slightly arcuate, median surface more markedly arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface shining, finely and sparsely punctulate. Submentum finely and sparsely punctulate. Genae moderately shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with punctation slightly smaller than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.38 mm; maximum width (at approximately midlength) 0.48 mm; sides margined, denticulate; sides relatively weakly produced at middle, slightly arcuate and slightly convergent to anterior angle, very slightly sinuate and slightly convergent to posterior; anterior border 0.40 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.44 mm wide, slightly arcuate to rear. Posterointernal foveolae absent; punctures in foveola similar to those on disc. Posteroexternal foveola absent. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended slightly less than 0.33 width of anterior region of pronotum. Transverse foveola absent. Disc shining, punctures fine, separated by puncture diameter near anterior and posterior borders, and by two-three times puncture diameter in middle; most punctures with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered, apex blunt, width at apex 0.33 distance between internal and median carinae. Metasternum with plaques very slightly developed, small ovals at posterior 0.20; width of each plaque 0.50 width of

intercoxal process at its apex; plaques separated posteriorly by approximately four times plaque width; plaques flat in cross section. *Elytra:* Length 0.92 mm. Maximum width (at midlength) 0.64 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to puncture diameter, as are interstices between adjacent punctures of row; each puncture with seta. Explanate margin quite narrow, ended near posterior 0.20, with fine serrations near anterior angles and in posterior 0.33; serrations somewhat closer near apices. Elytral apices, in dorsal aspect, truncate; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex clearly produced, arched ventrad. Tergum 7 emarginate at apex; sternum with small, oval excavation on inner surface distinctly to left of midline. *Legs:* Profemur with tubercle on inner surface near midlength. Protibia slightly arcuate, excavate at apex. Metatibia nearly parallel-sided in apical 0.80. *Genitalia:* Aedeagus as illustrated (Fig. 55B)(1 examined).

Distribution. – (Fig. 172B). Presently known only from the type-locality, Turrialba, Costa Rica.

Etymology. – Latin in form, noun in apposition, *turrialba* in reference to the type-locality.

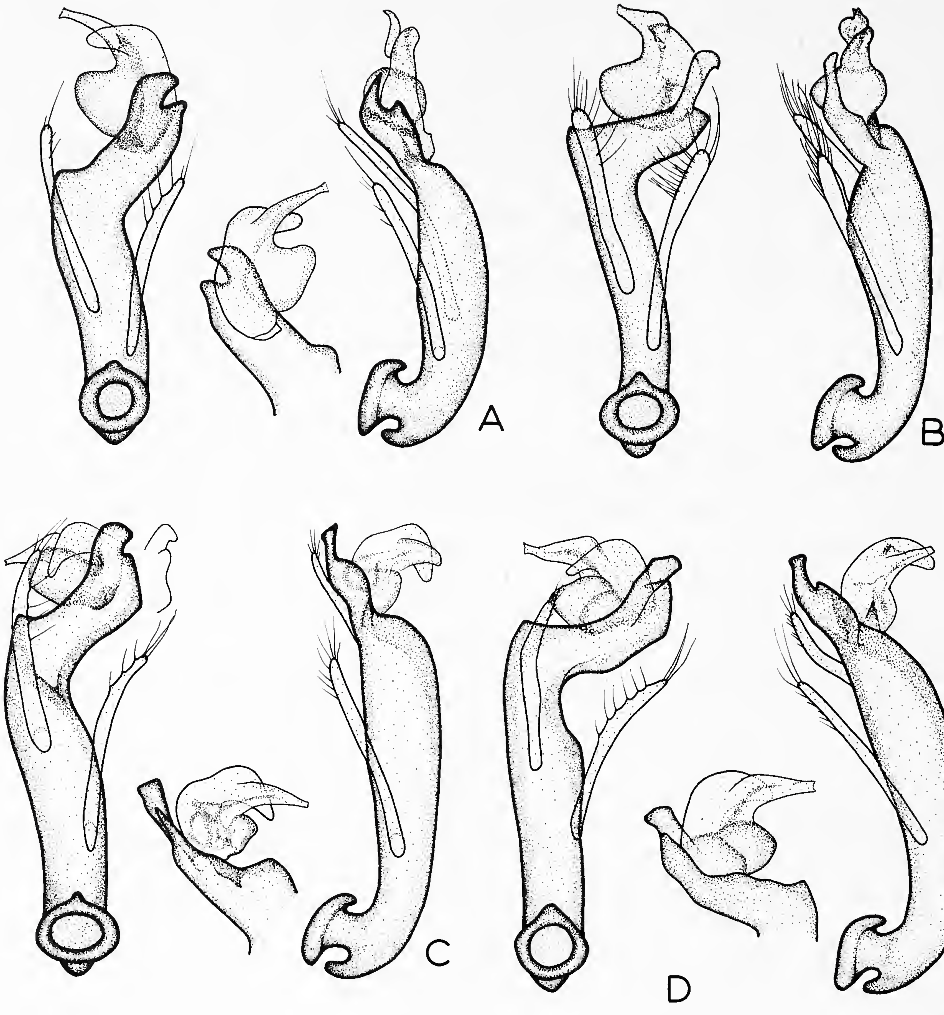
80. *Hydraena pulsatrix* new species
(Figs. 55C,56A,172B)

Type-locality. – Ciudad Mante, Tamaulipas, Mexico.

Type-specimens. – The holotype male and allotype with identical data are deposited in USNM. Paul J. Spangler collected these specimens, August 22, 1964. Paratypes (32) are listed in the appendix.

Diagnosis. – The aedeagus must be used to distinguish males of this species from others in the *marginicollis* Subgroup which are in its size range (about 1.56 mm long) and lack metasternal plaques. It is very closely related to *H. longicollis*.

Description. – *Form:* Elongate. *Size:* Holotype 1.56 mm long, 0.56 mm wide. *Color:* Head with dorsal surface dark brown, nearly black; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum testaceous at anterior and posterior 0.22, dark brown in middle 0.56; testaceous areas slightly larger at anterior and posterior angles; macula slightly lighter at sides of pronotum. Elytra brown. Ventral surface dark brown except legs, elytral epipleura, apex of abdomen, and inflexed margin of pronotum testaceous. *Head:* Length 0.20 mm. Width 0.36 mm. Frons finely and sparsely punctured, interstices one-two puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely punctulate. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.24/0.10/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface very slightly arcuate, median surface more markedly arcuate; palpomere 4 widest near midlength. Mentum width equal length, surface moderately shining, finely and sparsely punctulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with punctation similar to that of submentum. Last five antennomeres pubescent. Eyes 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm. maximum width (at approximately midlength) 0.46 mm; sides margined, denticulate; sides relatively slightly produced at middle, slightly arcuate and slightly convergent to anterior angle, very slightly sinuate and slightly convergent to posterior; anterior border 0.40 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.44 mm wide, slightly arcuate to rear. Posterointernal, posteroexternal and transverse foveolae absent. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended slightly less than 0.33 width of anterior region of pronotum. Disc shining, punctures fine, separated by one-two times puncture diameter; each puncture with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina, lätter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel, apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with plaques absent. *Elytra:* Length 0.96 mm. Maximum width (at midlength) 0.56 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.50 puncture diameter, as are interstices between adjacent punctures of a row; each puncture with seta. Explanate margin quite narrow, ended near posterior 0.20, with fine serrations near anterior angles and posterior 0.33. Elytral apices, in dorsal aspect, almost truncate; viewed posteriorly, elytral margin extended obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex greatly produced. Tergum 7 emarginate at apex; sternum with



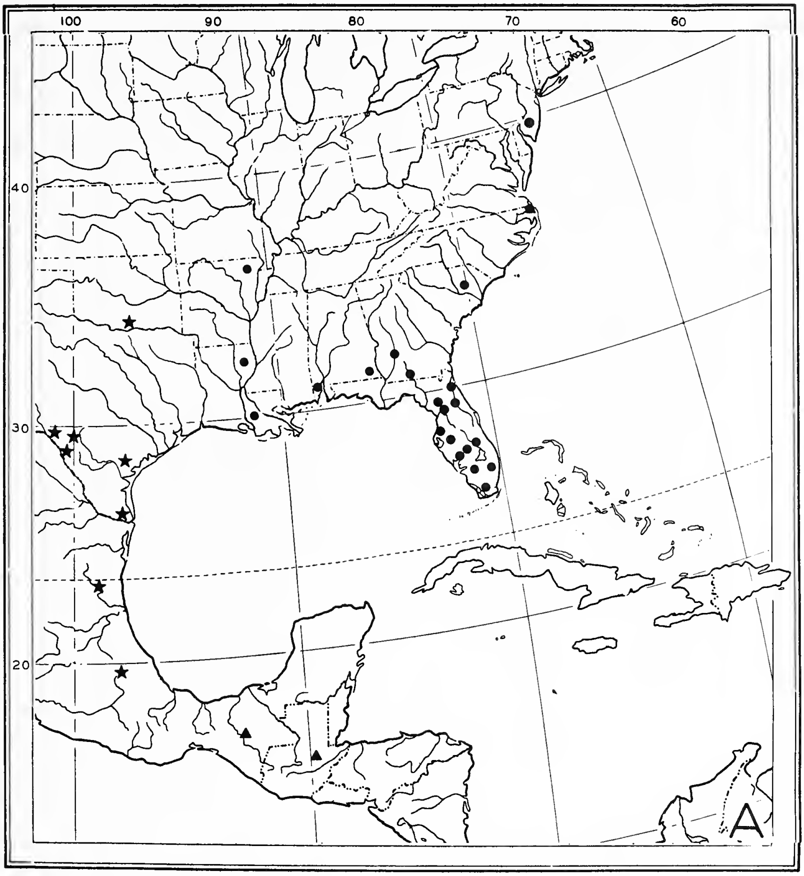
Figs. 55A – D, Aedeagi of *Hydraena* species. (A) *H. marginicollis*, neotype (inset: apex rotated slightly). (B) *H. turrialba*, holotype. (C) *H. pulsatrix*, holotype (inset: apex rotated slightly). (D) *H. longicollis*, lectotype (inset: apex rotated slightly).

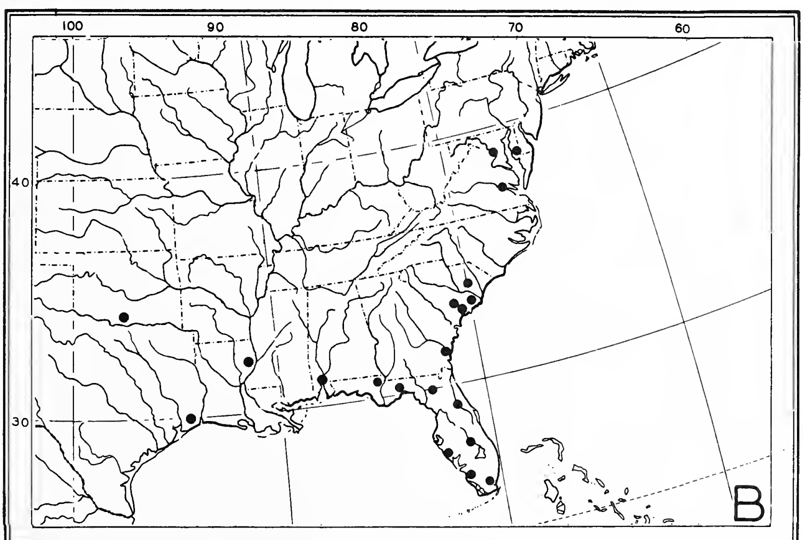
oval excavation on inner surface to left of midline. *Legs:* Profemur with small tubercle on inner surface near midlength. Protibia excavate on inner surface at apex. Metatibia nearly parallel sided in apical 0.66. *Genitalia:* Aedeagus as illustrated (Fig. 55C)(19 examined).

Natural History. – Locality data include the habitat notations, "mucky dead grass mat, margin of small lake", "streamside litter under cypress", and "floor, willow swamp".

Distribution. – (Figs. 56A,172B). Texas to southern Mexico.

Etymology. – Latin, *pulsator* (striker, beater). I have observed that *H. marginicollis* males, during copulation, pulsate the aedeagus forward and backward at a frequency of approximately two pulsations per second. In light of the structural similarity of the aedeagi of ***H. pulsatrix***





Figs. 56A – B, Geographical distributions of *Hydraena* species. (A) *H. marginicollis* ●, *H. pulsatrix* ★ and *H. longicollis* ▲. (B) *H. spangleri*.

and *H. marginicollis*, I predict that this behavior will also be found in the former species.

Remarks. – The differences in the aedeagi of *H. pulsatrix* and *H. longicollis* are slight but apparently constant.

81. *Hydraena longicollis* Sharp (Figs. 55D,56A,172B)

Hydraena longicollis Sharp, 1882:93 (lectotype male deposited in BMNH, here designated; type-locality: San Geronimo, Baja Verapaz, Guatemala).

Diagnosis. – The aedeagus must be used to differentiate males of *H. longicollis* from those of other species in the *marginicollis* Subgroup which are of approximately the same size, about 1.44 mm long, and have the plaques reduced to small ovals.

Description. – *Form:* Elongate. *Size:* Lectotype 1.44 mm long, 0.53 mm wide. *Color:* Head with dorsal surface and labrum black; maxillary palpi and antennae brown. Pronotum black except anterior angles and posterior border brown. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.18 mm. Width 0.34 mm. Frons moderately punctured, interstices one-four times puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely punctulate at sides, shining in middle. Labroclypeal suture arcuate when viewed from above. Labrum bilobed; surface punctulate; each lobe symmetrical arc; median emargination ended slightly before midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively; 0.26/0.12/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight, median surface arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface moderately shining, finely punctulate. Submentum punctation coarser and closer than mentum. Genae shining with irregular sculpture in form of transverse lines; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with close and fine punctation. Last five antennomeres pubescent. Eyes 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.34 mm; maximum width (at approximately midlength) 0.44 mm; sides margined, denticulate; sides relatively slightly produced at middle, slightly arcuate and slightly convergent to anterior angle, very slightly sinuate and slightly convergent to posterior; anterior border 0.38 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.41 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola absent. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc shining, punctures fine, separated by two-four times puncture diameter; most punctures without distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae diverging from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered; apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with plaques moderately developed, straight, parallel; plaques 0.50 length of metasternum in midline; greatest width of each plaque subequal to width of intercoxal process at its apex; plaques separated posterior by approximately three times plaque width; plaques flat in cross section. *Elytra:* Length 1.00 mm. Maximum width (at midlength) 0.53 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to puncture diameter, as are interstices between adjacent punctures of row; most punctures with seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine, well separated serrations along anterior 0.66, serrations quite large and distinct in posterior 0.33, serrations somewhat closer near apices. Elytral apices, in dorsal aspect, truncate; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly equilateral triangle; posterior margin straight. Glabrous segments at apex moderately produced. Tergum 7 emarginate at apex; sternum with oval excavation on inner surface to left of midline. *Legs:* Profemur with tubercle on inner surface near midlength. Protibia excavate on inner surface at apex. Metatibia gradually enlarging to apex. *Genitalia:* Aedeagus as illustrated (Fig. 55D)(8 examined).

Distribution. – (Figs. 56A,172B). Presently known from southern Mexico, Guatemala, and Nicaragua. I have examined 15 specimens (see appendix).

82. *Hydraena peru* new species (Figs. 58A,172B)

Type-locality. – Tingo Maria, Huanuco, Peru.

Type-specimens. – The holotype male, allotype and one female paratype with same data are deposited in USNM. Paul and Phyllis Spangler collected these specimens, April 19-24, 1969.

Diagnosis. – Moderately small body size plus geographical distribution (Peru) is of some aid in assigning specimens to this species. Positive identifications should be based upon the aedeagus (Fig. 58A).

Description. – *Form:* Elongate. *Size:* Holotype 1.32 mm long, 0.60 mm wide. *Color:* Head with dorsal surface black; labrum black; maxillary palpi testaceous; antennae testaceous. Pronotum testaceous at anterior and posterior 0.25, very dark brown in middle 0.50; sides much lighter brown than disc. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.18 mm. Width 0.34 mm. Frons finely and sparsely punctured, interstices one-three times puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely microreticulate at sides, shining in midline. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with follwing lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.22/0.08/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface slightly arcuate, median surface more markedly arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface shining, finely and sparsely punctulate. Submentum finely and sparsely punctulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with punctation slightly smaller than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 intercular distance in width. *Thorax:* Pronotum length at midline 0.34 mm. maximum width (at approximately midlength) 0.44 mm; sides margined, denticulate; sides relatively weakly produced at middle, slightly arcuate and slightly convergent to anterior angle, very slightly sinuate and slightly convergent to posterior; anterior border 0.36 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.42 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola absent. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended slightly less than 0.33 width of anterior region of pronotum. Transverse foveola absent. Disc shining, punctures fine; separated by one-three times puncture diameter; most punctures with seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly into very short spine; coxae separated by thin, median carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad, sides tapered, apex blunt, width at apex 0.66 distance between internal and median carinae. Metasternum with plaques slightly developed, of small ovals at posterior 0.20; width of each plaque 0.50 width of intercoxal process at its midlength; plaques separated posteriorly by approximately three times plaque width; plaques flat in cross section. *Elytra:* Length 0.84 mm. Maximum width (at midlength) 0.60 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.50 puncture diameter, as are interstices between adjacent punctures of row; each puncture with seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine, well separated serrations along entire margin; serrations closer near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex well produced, directed ventrad. Tergum 7 emarginate at apex; sternum with oval excavation on inner surface in midline. *Legs:* Profemur with small tubercle on inner surface near midlength. Protibia excavate on inner surface at apex. Metatibia nearly parallel sided in apical 0.80. *Genitalia:* Aedeagus as illustrated (Fig. 58A)(1 examined).

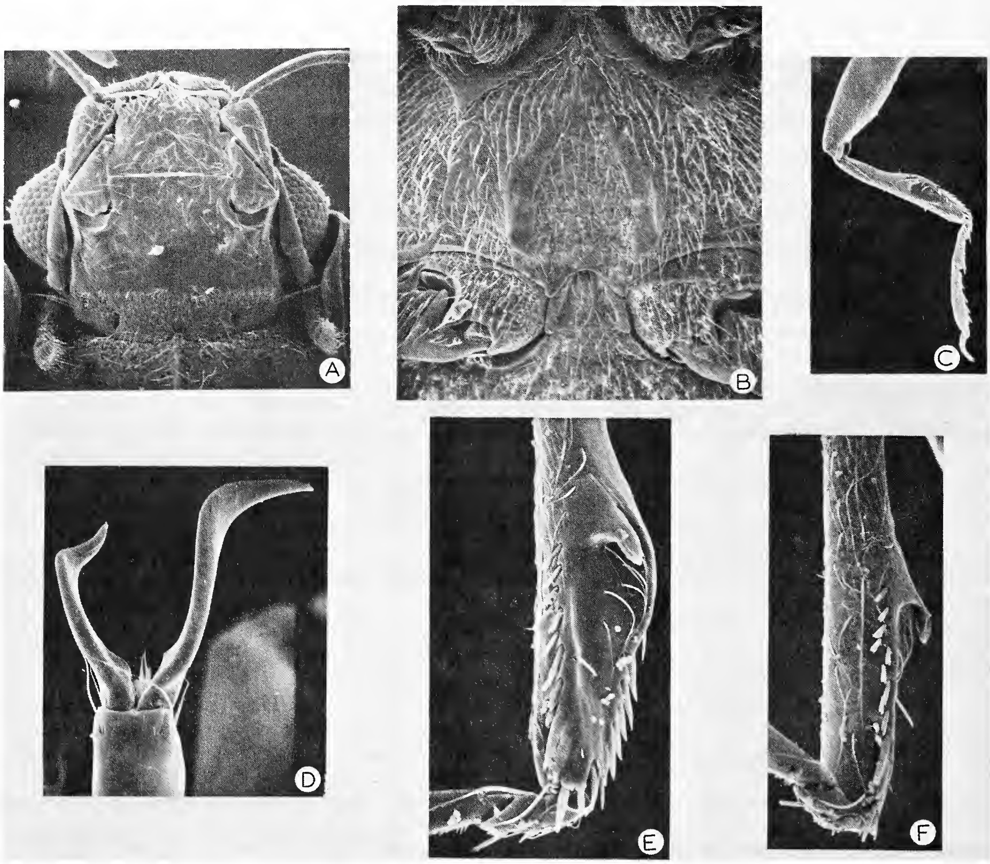
Distribution. – (Fig. 172B). Presently known only from the type-locality, Tingo Maria, Peru.

Etymology. – Noun in apposition, *peru*, in reference to the geographical distribution.

The *anisonycha* Complex

83. *Hydraena anisonycha* new species
(Figs. 2C,E,50B,57A-F,58B,153H)

Type-locality. – Eleven km. N. Bogotá, Cundinamarca, Colombia.



Figs. 57A – F, *Hydraena anisonycha*, ♂. (A) head, ventral aspect. (B) metasternum. (C) metathoracic leg. (D) mesotarsal claw. (E-F) Metatibia.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. Paul and Phyllis Spangler collected these specimens, March 1-8, 1969. Paratypes (1714), all also collected by the Spanglers, are listed in the appendix.

Diagnosis. – Adults of this very unusual species are characterized by the non-serial elytral punctation, plaques (Fig. 57B), which are carinate at the lateral margins, and large size, about 2.00 mm long. Males have the following autapomorphous features: 1) Shape of the hind tibiae (Figs. 57C,E-F); 2) very asymmetrical mesotarsal claws (Fig. 57D); 3) a median tubercle on abdominal sternum 2; and 4) aedeagal form (Fig. 58B).

Description. – *Form:* Elongate-oval. *Size:* Holotype 1.98 mm long, 0.84 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum testaceous at anterior and posterior 0.20, dark brown in middle 0.60. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.24 mm. Width 0.44 mm. Frons rather coarsely punctured, most interstices less than puncture diameter; surface shining. Frontoclypeal suture bisinuate. Clypeus microreticulate at sides,

shining in midline. Labroclypeal suture straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.34/0.16/0.24; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, arcuate in apical 0.66, median surface arcuate; palpomere 4 widest near apical 0.33. Mentum wider than long, surface moderately shining, finely microreticulate. Submentum microreticulate. Genae shining; lateral area of each gena with a well developed foveola; posterior ridge absent. Postgena with microreticulation similar to that of submentum. Last five antennomeres pubescent. Eyes 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.48 mm; maximum width (at approximately midlength) 0.64 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and convergent to anterior angle, very slightly sinuate and slightly convergent to posterior; anterior border 0.48 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.60 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola extremely weakly developed. Interfoveolar depression weakly developed. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc shining, punctures moderately sized, generally separated by less than puncture diameter; each puncture with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, slightly wider at apex than at midlength, apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with plaques well developed, arcuate; plaques 0.50 length of metasternum in midline; width of each plaque subequal to width of intercoxal process at its midlength; plaques separated posteriorly by approximately three times plaque width; each plaque with lateral margin carinate. *Elytra:* Length 1.36 mm. Maximum width (at midlength) 0.84 mm. Surface shining, disc with first two rows (from suture) somewhat distinct, other punctures randomly arranged; punctures with seta. Explanate margin moderately developed, ended near posterior 0.50, without distinctive serrations. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly equilateral triangle; posterior margin straight. Second complete sternum with tubercle in midline. Glabrous segments at apex well produced. Tergum 7 asymmetrical, emarginate and markedly concave at apex. *Legs:* Profemur with small carina on inner surface at base. Protibia arcuate, expanded in apical 0.50. Mesotibia slightly arcuate. Mesotarsal claws markedly asymmetrical; apical article of mesotarsus with prominent setae on inner surface. Metafemur broad, lateral surface markedly arcuate, medial surface sinuate. Metatibia markedly expanded on inner surface near apical 0.33. *Genitalia:* Aedeagus as illustrated (Fig. 58B)(60 examined).

Natural History. – Most of the known specimens were collected at the margins of ponds.

Distribution. – (Fig. 50B). Presently known only from the vicinity of Bogotá, Colombia.

Etymology. – Greek, *anios* (unequal) plus *onycha* (claw). This name refers to the markedly asymmetrical claws of the male mesotarsi.

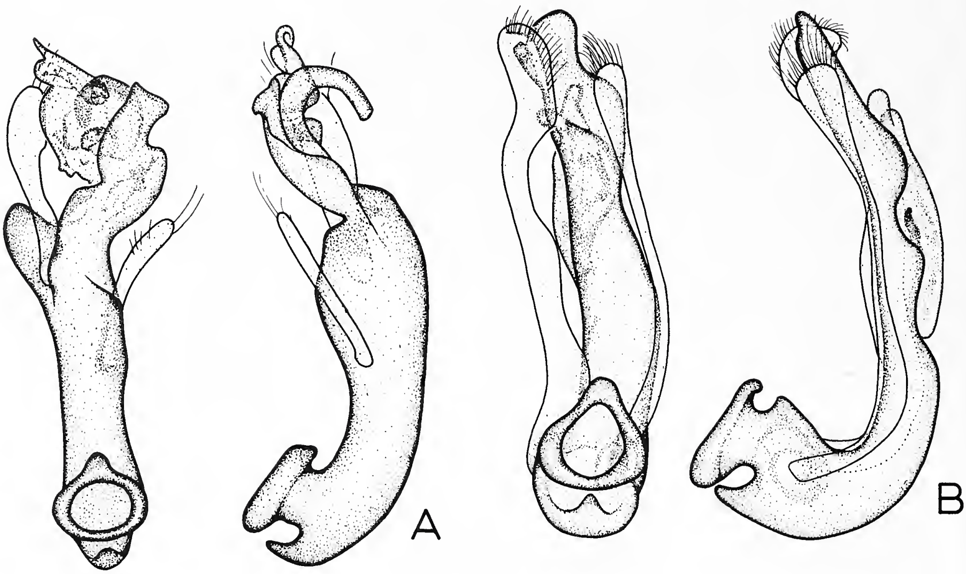
The *colymba* Complex

84. *Hydraena colymba* new species
(Figs. 59,60A,173)

Type-locality. – Six miles N. Jalapa, Jalapa, Guatemala.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. My wife Maureen and I collected these specimens, June 15, 1974. Paratypes (55) are listed in the appendix.

Diagnosis. – Moderately large size (about 1.60 mm long) and elongate plaques which are separated by three-four times the width of a plaque are of aid in distinguishing specimens of *H. colymba* from others in the *marginicollis* Subgroup . The very distinctive aedeagus (Fig. 60A) should be used for totally reliable identifications.



Figs. 58A – B, Aedeagi of *Hydraena* holotypes. (A) *H. peru.* (B) *H. anisonycha.*

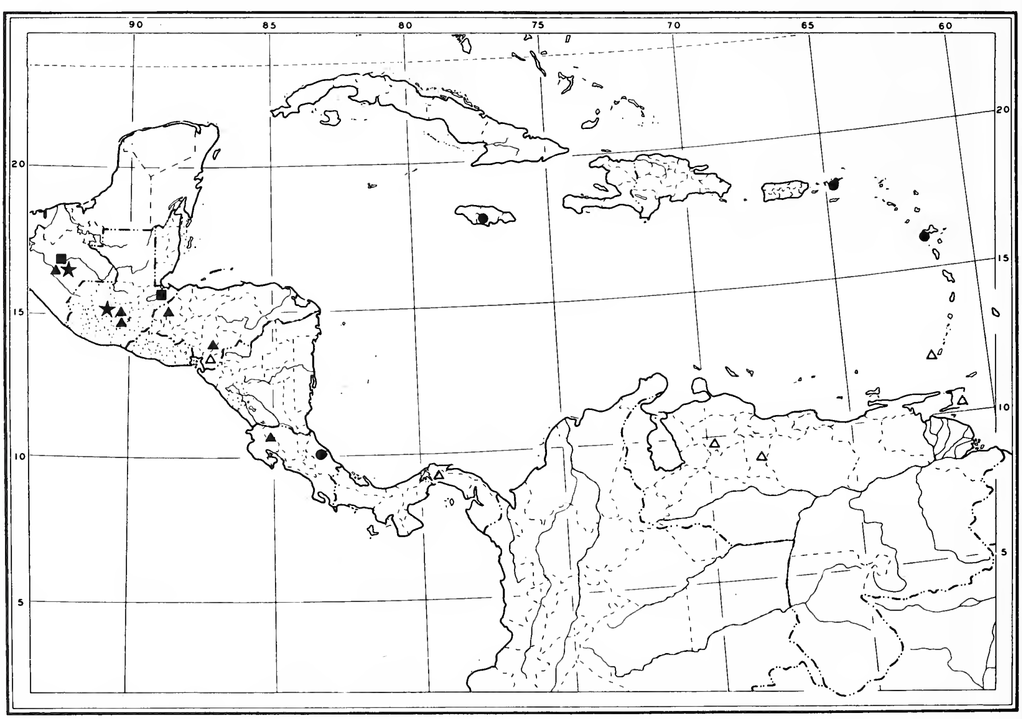


Fig. 59. Geographical distributions of *Hydraena guadelupensis* ●, *H. oblio* ★, *H. colymba* ▲, *H. particeps* △ and *H. sabella* ■.

Description. – *Form:* Elongate. *Size:* Holotype 1.60 mm long, 0.68 mm wide. *Color:* Head with dorsal surface black; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum testaceous at anterior and posterior 0.14, dark brown in middle 0.71; testaceous margin at sides as wide as anterior testaceous border. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.22 mm. Width 0.40 mm. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely punctulate at sides, shining in midline. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed; surface punctulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.28/0.12/0.18; palpomere 3 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight, median surface arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface shining, evenly and moderately finely punctulate. Submentum punctures unevenly distributed, forming aggregates. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with punctation smaller than that of submentum, punctures contiguous. Last five antennomeres pubescent. Eyes 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (at approximately midlength) 0.54 mm; sides margined, denticulate; sides relatively slightly produced at middle, slightly arcuate and slightly convergent to anterior angle, very slightly sinuate and slightly convergent to posterior; anterior border 0.44 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.50 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola absent. Interfoveolar depression very slightly developed. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc shining, punctures fine, separated by one-three times puncture diameter; most punctures with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad, sides nearly parallel; apex blunt, width at apex 0.66 distance between internal and median carinae. Metasternum with plaques moderately developed, straight, parallel; plaques 0.50 length of metasternum in midline, but anterior 0.50 of each plaque somewhat diffuse with pubescence; width of each plaque slightly less than width of intercoxal process at its apex; plaques separated posteriorly by approximately twice plaque width; plaques on sides of median depression, sloped slightly toward midline. *Elytra:* Length 1.00 mm. Maximum width (at midlength) 0.68 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to puncture diameter, as are interstices between adjacent punctures of a row; most punctures with seta. Explanate margin quite narrow, ended near posterior 0.10, with extremely fine serrations in apical 0.33. Elytral apices, in dorsal aspect, truncate; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex moderately produced. Tergum 7 emarginate at apex; sternum with circular excavation on inner surface. *Legs:* Protibia arcuate, gradually enlarged from base to apex. Metatibia gradually enlarged from base to apex. *Genitalia:* Aedeagus as illustrated (Fig. 60A)(26 examined).

Natural History. – The stream at the type-locality is rather slow, in an open, slightly arid area (Fig. 195A). *Limnebius sinuatus* adults were also collected at the margin of this stream. The only other habitat information available is the label notation, "in algae, rain pond".

Distribution. – (Figs. 59,173). From the mountains of Chiapas, Mexico south through Guatemala and Honduras to Costa Rica.

Etymology. – Latin, *colymba* (a diving bird). This name refers to the aedeagus, which has the apex shaped like a bird's head; and to the aquatic habits.

85. *Hydraena nevermanni* new species
(Figs. 60B,173)

Type-locality. – Hamburgfarm, Reventazon, Costa Rica.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. F. Nevermann collected these specimens, February 23, 1933. Paratypes (57) are listed in the appendix.

Diagnosis. – The small plaques of adults of this species are widely separated, the distance between them being about five-six times the width of a plaque. The pronotum is relatively

finely and sparsely punctate for a species of the *marginicollis* Subgroup , and the body size is moderate, about 1.34 mm long. The aedeagus is very distinctive, and should be used for totally reliable specimen assignment.

Description. – *Form:* Elongate. *Size:* Holotype 1.34 mm long, 0.56 mm wide. *Color:* Head with dorsal surface dark brown, nearly black; labrum dark brown; maxillary palpi and antennae testaceous. Pronotum testaceous at anterior and posterior 0.25, dark brown in middle 0.50; sides distinctly lighter than disc. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown. *Head:* Length 0.20 mm. Width 0.36 mm. Frons moderately finely punctured, interstices one-three times puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely punctulate at sides, shining in midline. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed; surface punctulate; each lobe symmetrical arc; median emargination at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.24/0.12/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface slightly arcuate, median surface more markedly arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface shining, finely and sparsely punctulate. Submentum punctures uneven, in form of aggregates. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with punctures fine and contiguous. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (at approximately midlength) 0.46 mm; sides margined, denticulate; sides relatively weakly produced at middle, slightly arcuate and slightly convergent to anterior angle, very slightly sinuate and slightly convergent to posterior; anterior border 0.40 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.42 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola absent. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area closer together than punctures on disc. Disc shining, punctures fine, separated by two-three times puncture diameter; most punctures with seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel, apex blunt, width at apex slightly less than 0.50 distance between internal and median carinae. Metasternum with plaques very slightly developed, of small ovals at posterior 0.20; width of each plaque 0.33 width of intercoxal process at its apex; plaques separated posteriorly by approximately six times plaque width; plaques flat in cross section. *Elytra:* Length 0.84 mm. Maximum width (at midlength) 0.56 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.50 puncture diameter, as are interstices between adjacent punctures of a row; most punctures with a seta. Explanate margin quite narrow, ended near posterior 0.20, without perceptible serrations. Elytral apices, in dorsal aspect, truncate; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex moderately produced. Tergum 7 emarginate at apex, sternum with round excavation on inner surface in midline. *Legs:* Protibia arcuate; inner surface expanded in apical 0.33. Metatibia gradually enlarged from base to apex. *Genitalia:* Aedeagus as illustrated (Fig. 60B)(26 examined).

Distribution. – (Fig. 173). Presently known only from the type-locality in Costa Rica.

Etymology. – Dedicated to the collector.

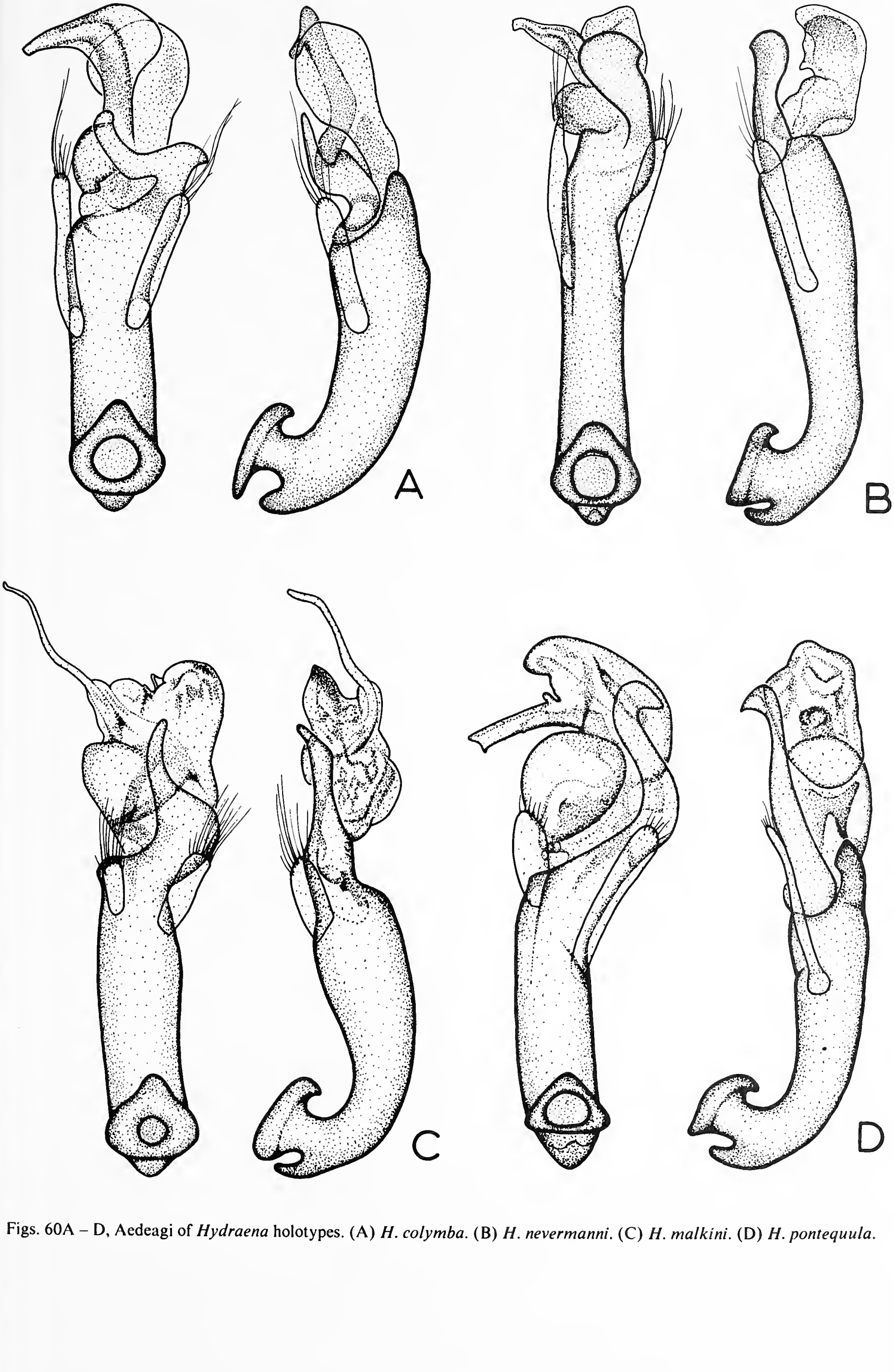
86 *Hydraena malkini* new species (Figs. 60C,173)

Type-locality. – Tres Rios, Costa Rica.

Type-specimens. – The holotype male is deposited in CAS. One male paratype (USNM) is labelled: Palmares, tiny pool in hard shale, high on riverbank, 7-XII-1955. Both of these specimens were collected by Borys Malkin.

Diagnosis. – Adults are moderately large, about 1.44 mm long, with plaques narrow, about three times as long as wide; a distance equal to about two-three times the width of a plaque separates them. The aedeagus must be employed to discriminate males of *H. malkini* from males of other members of the *marginicollis* Subgroup of similar body size and plaque configuration.

Description. – *Form:* Elongate. *Size:* Holotype 1.44 mm long, 0.60 mm wide. *Color:* Head with dorsal surface black, faint purple reflections apparent; labrum black; maxillary palpi and antennae testaceous. Pronotum testaceous at



Figs. 60A – D, Aedeagi of *Hydraena* holotypes. (A) *H. colymba.* (B) *H. nevermanni.* (C) *H. malkini.* (D) *H. pontequula.*

anterior and posterior 0.25, dark brown in middle 0.50; sides lighter than disc. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum testaceous. *Head:* Length 0.20 mm. Width 0.34 mm. Frons finely and sparsely punctured, interstices two-three times puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely microreticulate at sides, shining in midline. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.24/0.12/0.14; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight, median surface arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface shining, finely and extremely sparsely punctulate. Submentum shining, nearly impunctate. Genae moderately elevated, shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena punctures fine and contiguous. Last five antennomeres pubescent. Eyes slightly less than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (at approximately midlength) 0.46 mm; sides margined, denticulate; sides relatively slightly produced at middle, slightly arcuate and slightly convergent to anterior angle, slightly sinuate and convergent to posterior; anterior border 0.40 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.42 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola absent. Interfoveolar depression very slightly developed. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc extremely shiny, punctures fine and sparse, separated by two-four times puncture diameter; punctures without distinctive setae extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad, sides parallel; apex blunt, width at apex 0.66 distance between internal and median carinae. Metasternum with plaques moderately developed, straight, parallel; plaques 0.40 length of metasternum in midline; width of each plaque subequal to width of intercoxal process at its apex; plaques separated posteriorly by approximately twice plaque width; plaques on sides of median depression, sloped toward midline. *Elytra:* Length 0.88 mm. Maximum width (at midlength) 0.60 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to twice puncture diameter, as are interstices between adjacent punctures of row; most punctures with seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine, well separated serrations along entire margin; serrations slightly closer near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex moderately produced. Tergum 7 emarginate at apex; sternum with oval excavation on inner surface in midline. *Legs:* Protibia expanded on inner surface in apical 0.33. Meso- and metatibia slightly arcuate in apical 0.33. *Genitalia:* Aedeagus as illustrated (Fig. 60C)(2 examined).

Variation. – The paratype from Palmares has the pronotal and mental punctation decidedly more dense than that of the holotype.

Distribution. – (Fig. 173). Presently known only from Costa Rica.

Etymology. – I am pleased to dedicate this species to its collector, Borys Malkin, in recognition of the many specimens made available to this study due to his excellent field work.

87. *Hydraena pontequula* new species
(Figs. 60D,173)

Type-locality. – Albrook Forest Site, Canal Zone, Panama.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. These specimens were collected by Hutton, January 19-20, 1968. Paratypes (165) are listed in the appendix.

Diagnosis. – Small body size, about 1.14 mm long, and plaques elongate and separated from one another by about four times the width of a plaque, help to distinguish specimens of *H. pontequula.* The very distinctive aedeagus (Fig. 60D) must be used to reliably distinguish between males of this species and others in the *marginicollis* Subgroup of similar body size and plaque configuration.

Description. – *Form:* Elongate. *Size:* Holotype 1.14 mm long, 0.48 mm wide. *Color:* Head with dorsal surface brown; labrum dark brown; maxillary palpi and antennae testaceous. Pronotum testaceous except for transverse, rectangular, brown (lighter than head) macula on disc. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum testaceous. *Head:* Length 0.16 mm. Width 0.32 mm. Frons moderately punctate, interstices equal to or slightly greater than puncture diameter; surface shining. Frontoclypeal suture arcuate to rear. Clypeus finely microreticulate at sides, shining in midline. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended slightly above midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.20/0.08/0.14; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight, median surface arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface shining, finely and sparsely punctulate. Submentum finely and sparsely punctulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena microreticulate. Last five antennomeres pubescent. Eyes slightly less than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.28 mm; maximum width (at approximately midlength) 0.40 mm; sides margined, denticulate; relatively weakly produced at middle, slightly arcuate and slightly convergent to anterior angle, very slightly sinuate and slightly convergent to posterior; anterior border 0.32 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.36 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola absent. Anteroexternal foveolae well developed, each foveola somewhat cresent shaped, extended slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc shining, punctures fine, separated by puncture diameter; most punctures with seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel; apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with plaques moderately developed, straight, parallel; plaques 0.43 length of metasternum in midline; width of each plaque less than width of intercoxal process at its apex; plaques separated posteriorly by approximately four times plaque width; plaques flat in cross section. *Elytra:* Length 0.72 mm. Maximum width (at midlength) 0.48 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus; most punctures round; intervals not elevated, width approximately equal to puncture diameter, as are interstices between adjacent punctures of row; most punctures with seta. Explanate margin quite narrow, ended near posterior 0.20, without perceptible serrations. Elytral apices, in dorsal aspect, almost truncate; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex only moderately produced. Tergum 7 emarginate at apex; sternum with oval excavation on inner surface in midline. *Legs:* Protibia very slightly expanded on inner surface in apical 0.33. *Genitalia:* Aedeagus as illustrated (Fig. 60D)(40 examined).

Natural History. – H. S. Dybas provides the label notation, "damp pockets of leaves and debris in streambed". Most of the specimens taken at ultraviolet light are teneral.

Distribution. – (Fig. 173). Panama, according to currently available data.

Etymology. – Latin, *pontus* (the open sea) plus *equula* (a small horse). The aedeagus has a form reminiscent of a sea horse.

88. *Hydraena sabella* new species
(Figs. 59,62A,173)

Type-locality. – Eight miles W. Teapa, Chiapas, Mexico.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. My wife Maureen and I collected these specimens, May 26, 1974. Paratypes (140) are listed in the appendix.

Diagnosis. – Adults are small, about 1.30 mm long, with plaques narrow and long, separated by twice the width of a plaque. The aedeagus must be used to distinguish *H. sabella* males from other members of the *marginicollis* Subgroup of similar body size and plaque configuration.

Description. – *Form:* Elongate. *Size:* Holotype 1.30 mm long, 0.52 mm wide. *Color:* Head with dorsal surface black, with slight purple relections; labrum black; maxillary palpi testaceous; antennae testaceous. Pronotum testaceous at anterior and posterior 0.22, dark brown (nearly black) in middle 0.56; sides slightly lighter than disc. Elytra brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum testaceous. *Head:* Length 0.20 mm. Width 0.35 mm. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter;

surface shining. Clypeus finely microreticulate at sides, shining in middle. Labroclypeal suture straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.24/0.12/0.14; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight, median surface arcuate; palpomere 4 widest slightly past midlength. Mentum width equal length, surface shining, finely and sparsely punctulate. Submentum microreticulate. Genae shining, moderately elevated; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with punctation nearly equal that of submentum. Last five antennomeres pubsescent. Eyes slightly larger than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (at approximately midlength) 0.44 mm; sides margined, denticulate; relatively slightly produced at middle, slightly arcuate and slightly convergent to anterior angle, very slightly concave and slightly convergent to posterior; anterior border 0.36 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.40 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola absent. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended slightly less than 0.33 width of anterior region of pronotum. Transverse foveola absent. Disc shining, punctures fine, separated by two-three times puncture diameter; punctures with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides tapered, apex blunt, width at apex 0.33 distance between internal and median carinae. Metasternum with plaques well developed, straight, nearly parallel; plaques 0.50 length of metasternum in midline; width of each plaque subequal to width of intercoxal process at its apex; plaques separated posteriorly by approximately twice plaque width; plaques flat in cross section. *Elytra:* Length 0.84 mm. Maximum width (at midlength) 0.52 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.50 puncture diameter, as are interstices between adjacent punctures of a row; punctures each with seta. Explanate margin quite narrow, ended near posterior 0.12, with fine serrations near apices. Elytral apices, in dorsal aspect, almost truncate; in posterior aspect, elytral margin elevated obliquely towards suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly equilateral triangle, posterior margin straight. Glabrous segments at apex well produced. Tergum 7 emarginate at apex, sternum with internal, circular depression. *Legs:* Profemur broad, with minute tubercle on inner surface near apical 0.33. Protibia excavate on inner surface at apex. Metatibia straight, gradually enlarged to apex. *Genitalia:* Aedeagus as illustrated (Fig. 62A)(10 examined).

Natural History. – The stream at the type-locality is moderately large and swift, surrounded by dense tropical vegetation (Fig. 193A). The beetles were removed from the sand-gravel margin.

Distribution. – (Figs. 59,173). According to the data presently available, found in the mountains of Chiapas, Mexico and Guatemala.

Etymology. – Greek, *sabella* (small sand, gravel). This name refers to the microhabitat substratum at the type-locality.

89. *Hydraena d-destina* new species
(Figs. 61A-D,62B,173,194A-B)

Type-locality. – 27 miles N. Comitan, Chiapas, Mexico.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. Two male paratypes with same data are deposited in PDP. These specimens were collected by my wife Maureen and I, July 1, 1974.

Diagnosis. – Both sexes are characterized by their large size, about 2.00 mm long, and plaque form, with anterior portion elevated slightly. Females are also distinguished by their metatibiae, which are slightly expanded at midlength. Males are instantly recognized by their greatly modified hind legs (Figs. 61A-D) which have massive femora and incredibly expanded, triangular tibiae.

Description. – *Form:* Elongate. *Size:* Holotype 2.02 mm long, 0.86 mm wide. *Color:* Dorsal surface dark brown except narrow border at anterior and posterior margins of pronotum and at elytral apices testaceous; maxillary palpi brown; antennae brown. Ventral surface dark brown except legs, elytral epipleura and inflexed margin of pronotum brown.

Head: Length 0.24 mm. Width 0.46 mm. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter; surface slightly shining. Frontoclypeal suture straight. Clypeus microreticulate. Labroclypeal suture straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended slightly above midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.34/0.16/0.24; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface arcuate at base, slightly expanded at apical 0.33, median surface sinuate; apical segment widest at apical 0.33. Mentum wider than long, surface moderately shining, punctures relatively large and widely spaced. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum.

Last five antennomeres pubescent. Eyes slightly less than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.48 mm; maximum width (at approximately midlength) 0.66 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and convergent to anterior angle, very slightly sinuate and convergent to posterior; anterior border 0.50 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.58 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Interfoveolar depression weakly developed. Area between external foveolae slightly elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended slightly less than 0.33 width of anterior region of pronotum. Transverse foveola not developed, punctures in this area somewhat closer together than punctures on disc. Disc shining, punctures small and deeply impressed, separated by 0.50 puncture diameter near anterior and posterior borders, by puncture diameter in middle; punctures with distinctive setae extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly into very short spine; coxae separated by thin, median carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process moderately narrow, slightly wider at apex than at midlength, apex blunt, width at apex 0.50 distance between internal and median carinae. Metasternum with plaques narrow, straight, convergent moderately from posterior to anterior; plaques 0.43 length of metasternum in midline; width of each plaque 0.50 width of intercoxal process at its apex; plaques separated posteriorly by approximately five times plaque width; most anterior limits of plaques elevated. *Elytra:* Length 1.40 mm. Maximum width (at midlength) 0.86 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus, rows quite regular; most punctures round; intervals not elevated, width approximately equal to 0.50 puncture diameter, as are interstices between adjacent punctures of a row; punctures each with seta. Explanate margin quite narrow, ended near posterior 0.20, with fine, well separated serrations near anterior angles and apical 0.33; serrations closer near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. Right elytron distinctly shorter than left. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex markedly produced, with shallow depression in midline. Segment 7 deeply emarginate at apex. Sternum 7 with circular excavation on inner surface. *Legs:* Profemur with oblique carina on inner surface near basal 0.33. Protibia expanded on inner surface in apical 0.33. Metafemur very broad, lateral surface extremely arcuate. Metatibia greatly expanded on inner surface. *Genitalia:* Aedeagus as illustrated (Fig. 62B)(3 examined).

Natural History. – These beetles were collected at the margin of a moderately rapid stream in the mountains of Chiapas, Mexico. The substratum contained a higher percentage of mud than is generally seen in streams supporting hydraenid populations (Figs. 194A-B).

Distribution. – (Fig. 173). Presently known only from the type-locality in the state of Chiapas, Mexico.

Etymology. – Latin, *d-* (Latin equivalent of the Greek delta, i.e. triangular) plus *destina* (support, prop). This name refers to the triangular metatibiae of the males (Figs. 61A-B), which must surely serve as props during copulation.

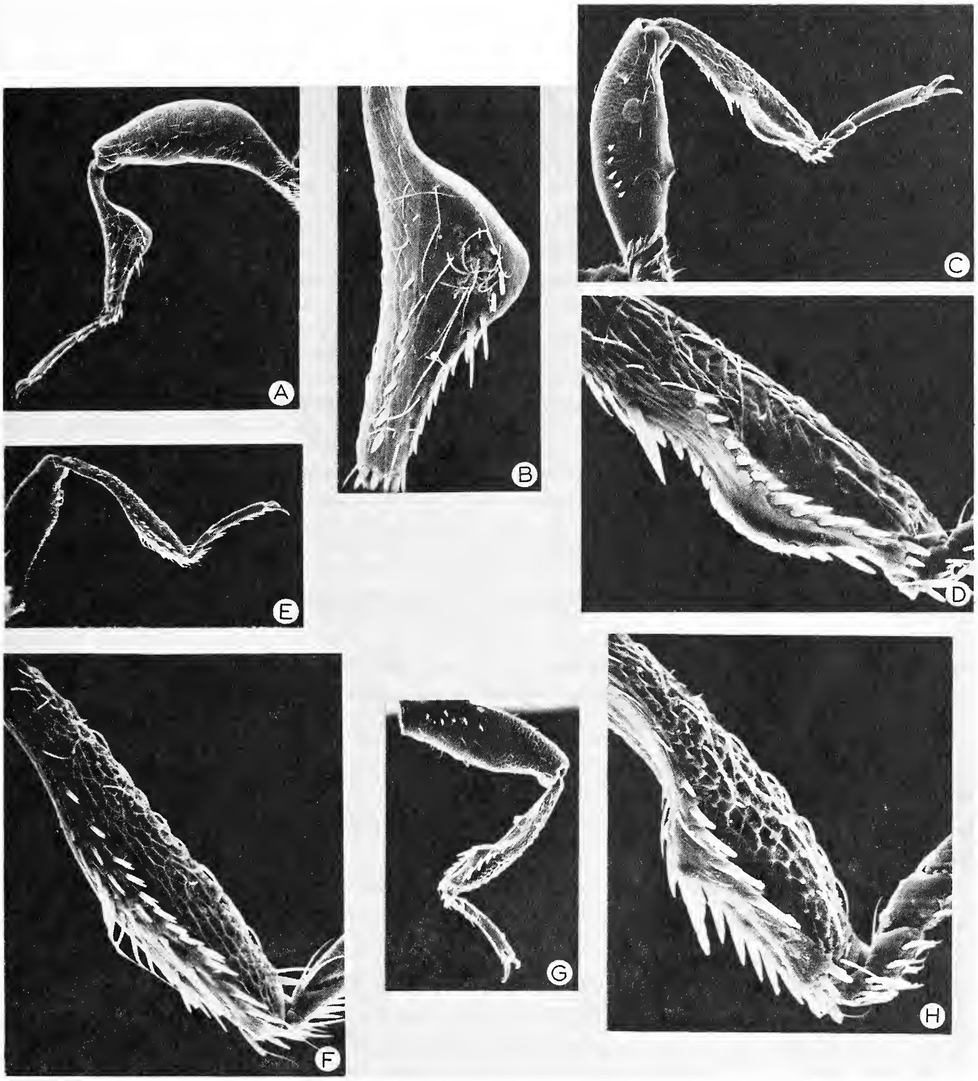
90. *Hydraena barricula* new species
(Figs. 62C,173)

Type-locality. – San Cristobal de las Casas, Chiapas, Mexico.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. Paul J. Spangler collected these specimens, July 17-21, 1964.

Diagnosis. – In addition to the distinctive aedeagus (Fig. 62C), this species is characterized by large size, about 1.84 mm long, and non-elevated plaques. Females have the metatibiae slightly wider at the middle than at either end. Males have the inner surface of the metatibiae angularly expanded, about 0.33 the size of that seen in *H. d-destina* (Fig. 61A); the outer surface is straight, not arcuate as in *H. d-destina.*

Description. – *Form:* Elongate. *Size:* Holotype 1.84 mm long, 0.80 mm wide. *Color:* Dorsal surface of head and disc of pronotum dark brown. Lateral areas of pronotum and elytra brown. Maxillary palpi testaceous; antennae testaceous. Ventral surface dark brown except legs; elytral epipleura, mentum and inflexed margin of pronotum brown. *Head:* Length 0.24 mm. Width 0.42 mm. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter; surface shining. Frontoclypeal suture very slightly arcuate to rear. Clypeus finely microreticulate at sides, shining in middle. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate; each lobe



Figs. 61A – H. (A–B) *Hydraena d-destina*, metathoracic leg of ♂. (C–D) *H. d-destina*, prothoracic leg of ♂. (E–F) *H. cuspidicollis*, metathoracic leg of ♂. (G–H) *H. cuspidicollis*, prothoracic leg of ♂.

symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.28/0.12/0.22; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, slightly arcuate in apical 0.66, median surface arcuate; palpomere 4 widest near apical 0.33. Mentum wider than long, surface moderately shining, finely punctulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (at approximately midlength) 0.60 mm; sides margined, denticulate, moderately produced at middle, slightly arcuate and convergent to anterior angle, slightly sinuate and convergent to posterior; anterior border 0.48 mm wide, straight and nearly perpendicular to midline in lateral 0.33, moderately arcuate to rear in middle 0.33; posterior border 0.56 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola absent. Interfoveolar depression absent. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended slightly less than 0.33 width of anterior region of pronotum. Transverse foveola slightly developed, punctures separated by approximately 0.50 puncture diameter. Disc shining, punctures moderately large and deeply impressed, separated by puncture diameter; many punctures with short seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad, slightly wider at apex than at midlength, apex blunt, width at apex 0.66 distance between internal and median carinae. Metasternum with plaques well developed, curved toward midline in apical 0.33; plaques 0.50 length of metasternum in midline; greatest width of each plaque less than width of intercoxal process at its apex; plaques separated posteriorly by approximately three times plaque width; plaques flat in cross section. *Elytra:* Length 1.24 mm. Maximum width (at midlength) 0.80 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus rows quite regular; most punctures round; intervals not elevated, width slightly less than puncture diameter, as are interstices between adjacent punctures of row; each puncture with seta. Explanate margin quite narrow, ended near posterior 0.17, with fine serrations near anterior angles and apical 0.33. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, nearly equilateral triangle, posterior margin very weakly arcuate. Glabrous segments at apex well produced, arching ventrally. Tergum 7 emarginate at apex; sternum with rounded excavation on inner surface, and corresponding rounded elevation on outer surface. *Legs:* Profemur with low, oblique carina on inner surface near basal 0.33. Protibia excavate on inner surface at apex. Metafemur broad, lateral surface markedly arcuate, medial surface sinuate. Metatibia expanded on inner surface slightly past midlength. *Genitalia:* Aedeagus as illustrated (Fig. 62C)(1 examined).

Distribution. – (Fig. 173). Presently known only from the type-locality in the mountains of Chiapas, Mexico.

Etymology. – Latin, *barra* (elephant) plus *icula* (diminutive). Named in reference to the proboscis-like process of the aedeagus.

91. *Hydraena splecoma* new species
(Figs. 62D,173,190A-B)

Type-locality. – Four miles N. Bochil, Chiapas, Mexico.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. Paratypes (12) with same data are deposited in USNM and PDP. These specimens were collected by my wife Maureen and I, May 28, 1974.

Diagnosis. – The aedeagus must be studied to assign males to this species with complete confidence. The plaques are well developed, on the sides of a median depression, sloped toward the midline. Each plaque is about as wide as the mesosternal process; about twice this distance separates the plaques from one another. Males have the protibiae expanded in the distal 0.50, with a notch near the distal 0.33; the metatibiae are gradually enlarged from base to apex; the abdominal apex is decidely emarginate and has a group of hairs on each side of the emargination. The moderately large size of *H. splecoma* adults, about 1.78 mm long, is also of some diagnostic aid.

Description. – *Form:* Elongate. *Size:* Holotype 1.78 mm long, 0.72 mm wide. *Color:* Head with dorsal surface and labrum dark brown; maxillary palpi and antennae testaceous. Pronotum dark brown except for narrow testaceous border; dark brown areas blending into testaceous areas. Elytra brown. Ventral surface dark brown except legs, elytral epipleura, mentum and inflexed margin of pronotum brown. *Head:* Length 0.22 mm. Width 0.40 mm. Frons moderately punctured, interstices equal to or slightly greater than puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely punctulate in middle, microreticulate at sides. Labroclypeal suture arcuate, nearly straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended slightly above midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.28/0.12/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight, median surface arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface moderately shining; punctures relatively large, separated by puncture diameter. Submentum microreticulate. Genae moderately elevated, shining; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with microreticulation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.17 interocular distance in width. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (at approximately midlength) 0.56 mm; sides margined, denticulate; sides moderately produced at middle, slightly arcuate and convergent to anterior angle, slightly sinuate and convergent to posterior; anterior border 0.44 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.52 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola delimited by very shallow depression with punctation somewhat closer than that of disc. Interfoveolar depression very slightly developed. Area between external foveolae very weakly elevated. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended slightly less than 0.33 width of anterior region of pronotum. Transverse foveola absent. Disc shining, punctures moderately large, separated by 0.50 puncture diameter near anterior and posterior borders, by puncture diameter in middle; each puncture with distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated by thin, median carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively broad; very slightly wider at apex than at midlength, apex blunt, width at apex slightly less than distance between internal and median carinae. Metasternum with plaques well developed, straight, parallel; each plaque slightly wider at base than at apex; plaques 0.50 length of metasternum in midline; greatest width of each plaque slightly less than width of intercoxal process at its apex; plaques separated posteriorly by approximately twice plaque width; plaques on sides on median depression, sloped toward midline. *Elytra:* Length 1.14 mm. Maximum width (at midlength) 0.72 mm. Surface shining, disc with 10 rows of punctures between suture and humeral callus rows quite regular; most punctures round; intervals not elevated, width approximately equal to puncture diameter, interstices between adjacent punctures of row slightly smaller; each puncture with distinctive seta. Explanate margin quite narrow, ended near posterior 0.17, with prominent serrations; serrations near anterior angles and in apical 0.33; smaller near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, posterior margin straight. Glabrous segments at apex moderately produced. Segment 7 deeply emarginate at apex, pubescent. *Legs:* Profemur with oblique carina on inner surface near basal 0.33. Protibia expanded on inner surface in apical 0.50, notched near apical 0.33. Metatibia gradually enlarged from base to apex, extremely slightly arcuate. *Genitalia:* Aedeagus as illustrated (Fig. 62D)(11 examined).

Natural History. – These beetles were collected at the margin of a small back water (stream overflow) area in the mountains of Chiapas (Figs. 190A-B). The stream, which was flowing through a pine forest, also contained *Hydraena mexicana* and *Limnebius sinuatus.*

Distribution. – (Fig. 173). Presently known only from the type-locality in the mountains of Chiapas, Mexico.

Etymology. – Greek, *splecoma* (sexual intercourse). When the type-series was collected they were placed directly into a rearing chamber in hope that they would eventually copulate and larval stages could be obtained in due course. Much to my surprise, when the rearing chamber was placed beneath the microscope for sorting of individuals, many of the beetles were already in copulo. During the days that followed, each time the rearing chamber was checked a number of copulating pairs were seen.

The *geminya* Subgroup

Members of the *geminya* Subgroup have the procoxae relatively widely separated, a small

shelf between the coxae and median carina (Fig. 63F). Additionally, the mesosternal process is broad, resulting in the mesocoxae being rather widely separated.

The tiny, relatively broad adults of this group are generally found on submerged plant debris in moderately fast water, the widely separated coxae apparently an adaptation to this habitat. All of the three species now known live in the mountains of Mexico, one each in the states of Jalisco, Oaxaca and Chiapas.

92. *Hydraena vela* new species
(Figs. 64B,171A)

Type-locality. – Eleven miles SW Compostela, Nayarit, Mexico.

Type-specimen. – The holotype male (unique) is deposited in USNM. My wife Maureen and I collected this specimen July 20, 1974.

Diagnosis. – Adults are distinguished from those of the two other members of the *geminya* Subgroup now known by the narrower pronotal fascia and narrower, more widely separated plaques. The fascia occupies the middle 0.33 of the pronotum whereas in *H. geminya* and *H. chiapa* the fascia occupies the middle 0.50. The plaques are very narrow and widely separated, a distance equal to about eight times the width of a plaque separating them posteriorly.

Description. – *Form:* Elongate-oval. *Size:* Holotype 1.14 mm long, 0.52 mm wide. *Color:* Head with dorsal surface brown, darker near eyes; labrum brown; maxillary palpi testaceous; antennae testaceous. Pronotum with distinct, brown, transverse macula across middle 0.33; anterior and posterior 0.33 testaceous. Elytra brown. Ventral surface brown except legs, elytral epipleura, apex of abdomen, mentum, and inflexed margin of pronotum testaceous. *Head:* Length 0.16 mm. Width 0.30 mm. Frons finely and sparsely punctured, interstices four-five times puncture diameter; surface very shiny. Frontoclypeal suture straight. Clypeus finely microreticulate near lateral margins, shining in middle. Labroclypeal suture straight across middle in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.20/0.08/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface nearly straight in basal 0.33, arcuate in apical 0.66, median surface evenly arcuate; palpomere 4 widest near apical 0.33. Mentum wider than long, surface very shiny, extremely finely and sparsely punctulate. Submentum evenly, finely punctulate, interstices equal to puncture diameter. Genae shining; lateral area of each gena with foveola; posterior ridge absent; genae not elevated above postgena. Postgena with punctation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly greater than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.28 mm; maximum width (at approximately midlength) 0.40 mm; sides margined, extremely finely denticulate; relatively weakly produced at middle, slightly arcuate and convergent to anterior angle, slightly arcuate and convergent to posterior; anterior border 0.32 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.36 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola absent. Anteroexternal foveolae moderately developed, each foveola somewhat crescent shaped, extended slightly less than 0.33 width of anterior region of pronotum. Transverse foveola absent. Disc very shiny, punctures fine, separated by four-five times puncture diameter; punctures without distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated from median carina by thin shelf, carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process broad, sides nearly parallel, apex blunt, width at apex equal distance between internal and median carinae. Metasternum with plaques well developed, arcuate, convergent markedly from posterior to anterior; plaques 0.50 length of metasternum in midline; each plaque thin, moderately elevated ridge; plaques separated posteriorly by approximately eight times plaque width. *Elytra:* Length 0.72 mm. Maximum width (at midlength) 0.52 mm. Surface very shiny, punctures very small and lightly impressed, somewhat serial in first three rows (from suture), otherwise randomly arranged; some punctures with very fine seta. Explanate margin quite narrow, ended near posterior 0.33, with extremely fine, well separated serrations near anterior angles. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, anterior angle broadly rounded; posterior margin straight. Glabrous segments at apex moderately produced. Segment 7 without emargination at apex. *Legs:* Protibia arcuate, expanded in apical 0.33. Metatibia gradually enlarged from base to apex. *Genitalia:* Aedeagus as illustrated (Fig. 64B)(1 examined).

Natural History. – This specimen was taken from a tropical stream which also contained *Limnebius mitus* and *Spanglerina frondsicola.*

Distribution. – (Fig. 171A). Presently known only from the type-locality in the hills of Nayarit, Mexico.

Etymology. – Latin, *vela* (sail). The aedeagus has a large sail-like structure.

93. *Hydraena chiapa* new species
(Figs. 64C,171A,192A-B)

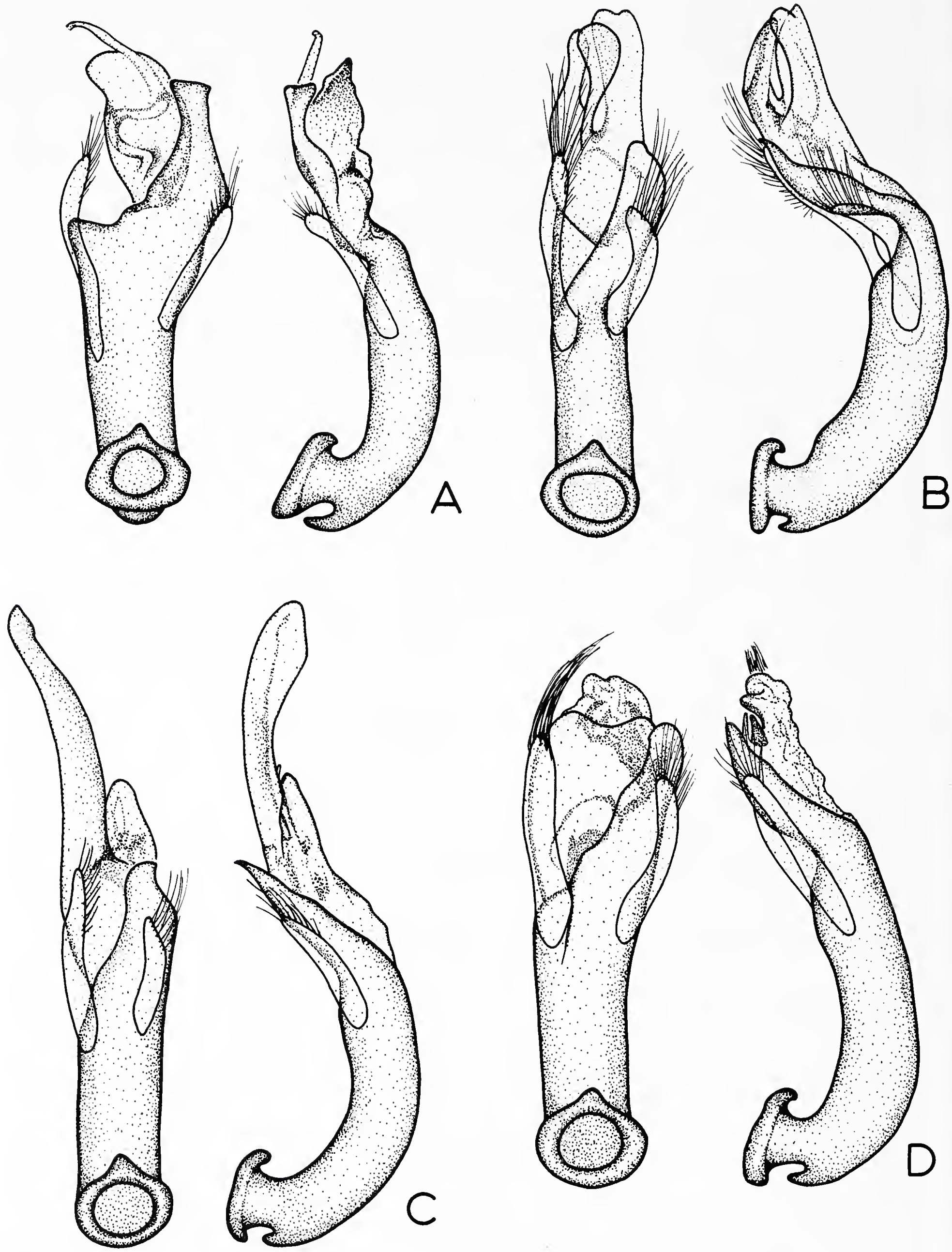
Type-locality. – Nine miles N. Tapilula, Chiapas, Mexico.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. My wife Maureen and I collected these specimens, May 27, 1974. One male and three female paratypes from the same locality are deposited in PDP. One male and five female paratypes (CNC) have the following data: Ocosingo, Chiapas, 2-VI-69, Bright and Campbell.

Diagnosis. – Very similar externally to *H. geminya*, differing in plaque configuration and aedeagus. The plaques are nearly parallel, separated at anterior by more than the length of a plaque.

Description. – *Form:* Elongate-oval. *Size:* Holotype 1.24 mm long, 0.64 mm wide. *Color:* Head with dorsal surface dark brown; labrum dark brown; maxillary palpi testaceous; antennae testaceous. Pronotum with a distinct, brown, transverse macula across middle 0.50; anterior and posterior 0.25 testaceous. Elytra brown. Ventral surface brown except legs, elytral epipleura, apex of abdomen, mentum, and inflexed margin of pronotum testaceous. *Head:* Length 0.18 mm. Width 0.34 mm. Frons finely and sparsely punctured, interstices two-three times puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely punctulate near lateral margins, shining in middle. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.20/0.08/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface weakly arcuate, median surface more strongly arcuate; palpomere 4 widest slightly past midlength. Mentum wider than long, surface shining, finely and sparsely punctulate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, extremely slightly elevated; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with punctation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline o.32 mm; maximum width (at approximately midlength) 0.46 mm; sides margined, denticulate; sides relatively slightly produced at middle, slightly sinuate and slightly convergent to anterior angle, slightly sinuate and slightly convergent to posterior; anterior border 0.38 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.42 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola very slightly developed. Anteroexternal foveolae moderately developed, each foveola somewhat crescent shaped, extended slightly less than 0.33 width of anterior region of pronotum. Transverse foveola absent. Disc shining, punctures fine, separated by two-three times puncture diameter; most punctures without distinctive seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated from median carina by shelf twice width of carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process very broad, sides parallel, apex blunt, width at apex greater than distance separating internal and median carinae. Metasternum with plaques well developed, straight, convergent moderately from posterior to anterior; plaques nearly 0.50 length of metasternum in midline; width of each plaque nearly 0.50 width of intercoxal process at its apex; plaques separated posteriorly by approximately 1.5 plaque width; plaques separated anteriorly by plaque width; plaques flat in cross section. *Elytra:* Length 0.80 mm. Maximum width (at midlength) 0.64 mm. Surface shining, disc with first four rows (from suture) of punctures fairly distinct, other punctures more or less randomly arranged; punctures very fine, interstices two-three times puncture diameter; some punctures with very fine seta. Explanate margin quite narrow, ended near posterior 0.33 with extremely fine, well separated serrations near anterior angles. Elytral apices in dorsal aspect gradually rounded; in posterior aspect, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long; anterior angle broadly rounded; lateral angles acute; posterior margin straight. Glabrous segments at apex moderately produced. Segment 7 without emargination at apex. *Legs:* Protibia slightly arcuate. Metatibia gradually enlarged to apex. *Genitalia:* Aedeagus as illustrated (Fig. 64C)(3 examined).

Natural History. – Specimens from the type-locality were on leaves and twigs trapped behind rocks in a tropical brook (Figs. 192A-B). They were in association with *Spanglerina*



Figs. 62A – D, Aedeagi of *Hydraena* holotypes. (A) *H. sabella.* (B) *H. d-destina.* (C) *H. barricula.* (D) *H. splecoma.*

brevis.

Distribution. – (Fig. 171A). Presently known only from the mountains of Chiapas, Mexico.

Etymology. – *chiapa*, in reference to the geographical distribution.

94. *Hydraena geminya* new species
(Figs. 63A,C,E-G,64D,171A)

Type-locality. – Four miles S. Valle Nacional, Oaxaca, Mexico.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. Paratypes (19) from the same locality are deposited in USNM, CAS and PDP. My wife Maureen and I collected these specimens July 6, 1974.

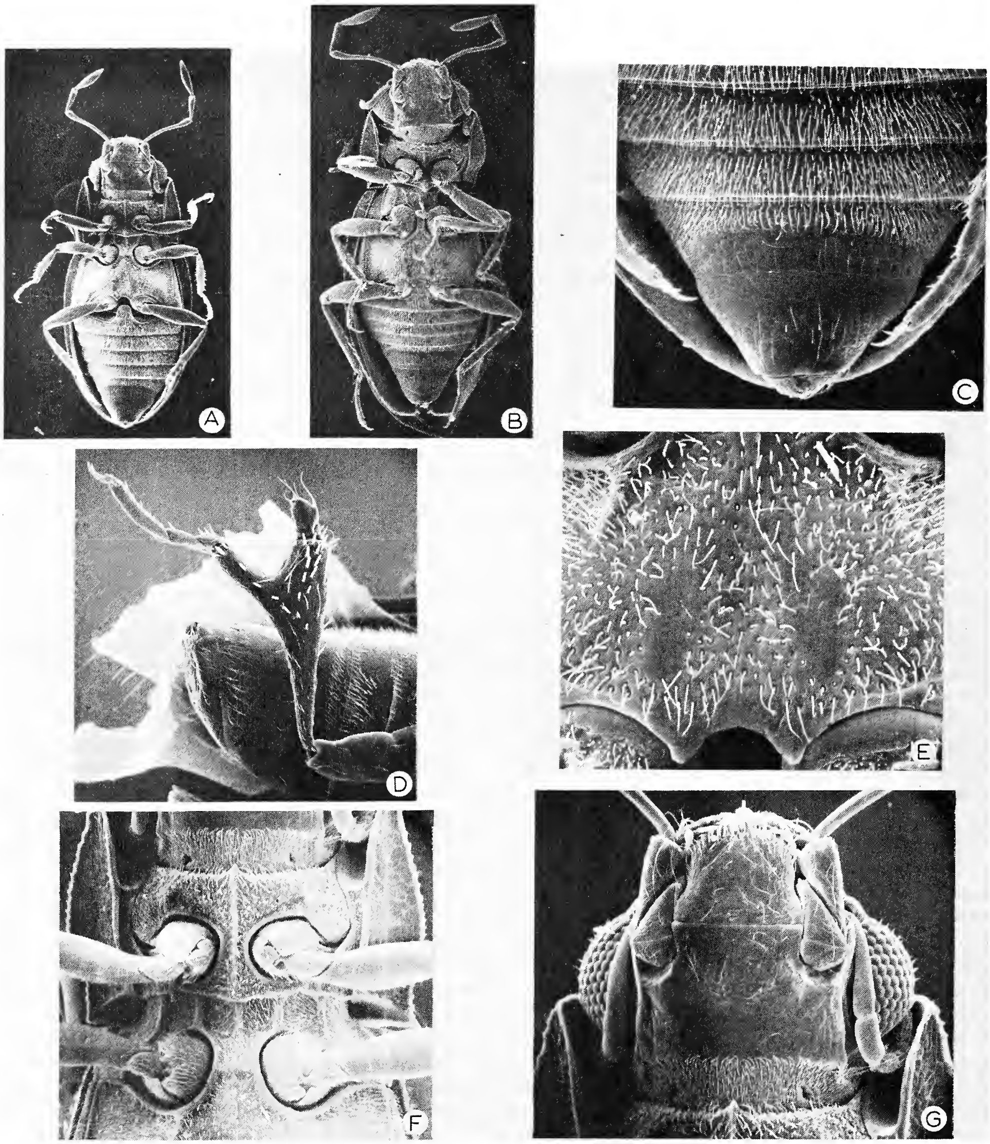
Diagnosis. – Distinguished from other members of the *geminya* Subgroup by the plaques, which are convergent anteriorly, separated at anterior by less than the length of a plaque. Externally adults are very similar to thse of *H. chiapa*, differences in the plaque configuration being rather slight in comparison to differences in the aedeagi (Figs. 64C-D).

Description. – *Form:* Elongate-oval. *Size:* Holotype 1.18 mm long, 0.56 mm wide. *Color:* Head with dorsal surface and labrum dark brown; maxillary palpi and antennae testaceous. Pronotum testaceous at anterior and posterior 0.25, dark brown in middle 0.50; sides slightly lighter than middle. Elytra brown. Ventral surface brown except legs, elytral epipleura, mentum, abdominal apex and inflexed margin of pronotum testaceous. *Head:* Length 0.18 mm. Width 0.32 mm. Frons finely and sparsely punctured, interstices three-four times puncture diameter; surface shining. Frontoclypeal suture straight. Clypeus finely punctulate at sides, shining in midline. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination ended at approximately midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.20/0.08/0.16; palpomere 2 bent outward at approximately midlength; apices of palpomere 2 and 3 not especially expanded; palpomere 4 with lateral surface very slightly arcuate, median surface arcuate; palpomere 4 widest near midlength. Mentum wider than long, surface shining, finely and sparsely punctulate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, extremely slightly elevated; lateral area of each gena with well developed foveola; posterior ridge absent. Postgena with punctation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes slightly less than 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.30 mm; maximum width (at approximately midlength) 0.44 mm; sides margined, denticulate, relatively weakly produced at middle, slightly arcuate and slightly convergent to anterior angle, slightly sinuate and slightly convergent to posterior; anterior border 0.36 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.40 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal foveola extremely weakly developed. Interfoveolar depression absent. Anteroexternal foveolae well developed, each foveola somewhat crescent shaped, extended slightly less than 0.33 width of anterior region of pronotum. Transverse foveola absent. Disc shining, punctures fine and sparse, separated by three-four times puncture diameter; few punctures with indistinct setae extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine; coxae separated from median carina by shelf slightly wider than carina, latter sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process very broad, sides parallel, apex blunt, width slightly greater than distance between internal and median carinae. Metasternum with plaques well developed, straight, convergent moderately from posterior to anterior; plaques 0.50 length of metasternum in midline; width of each plaque 0.33 width of intercoxal process; plaques separated posteriorly by approximately twice plaque width; plaques flat in cross section. *Elytra:* Length 0.76 mm. Maximum width (at midlength) 0.56 mm. Surface shining, disc with first three rows (from suture) of punctures fairly distinct, other punctures more or less randomly arranged; punctures very fine, interstices two-four times puncture diameter; most punctures with very fine seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine serrations near anterior angles. Elytral apices, in dorsal aspect, gradually rounded; viewed posteriorly, elytral margin elevated obliquely toward suture, in form of angle with opposite elytron. *Abdomen:* Intercoxal segment flat, wider than long, anterior angle rounded; posterior margin straight. Glabrous segments at apex only moderately produced. Segment 7 without emargination at apex. *Legs:* Protibia slightly arcuate. Metatibia slightly wider at midlength than at apex. *Genitalia:* Aedeagus as illustrated (Fig. 64D)(9 examined).

Natural History. – These beetles were removed from twigs, leaves and other debris taken from a small tropical cascade. Consocies included *Spanglerina brevis* and *Elmoparnus pandus* (see Spangler and Perkins, 1977, figure 19).

Distribution. – (Fig. 171A). Presently known only from the type-locality in the mountains of Oaxaca, Mexico.

Etymology. – *geminya*, a miscellaneous assemblage of letters.



Figs. 63A – G. (A) *Hydraena geminya* ♂, ventral habitus. (B) *H. pontequula* ♂, ventral habitus. (C) *H. geminya* ♂, abdominal apex. (D) *H. pontequula*, deformed metatibia. (E) *H. geminya*, metasternum. (F) *H. geminya*, pro– and mesosternum. (G) *H. geminya*, head, ventral aspect.

The *paeminosa* Group

Adults of the single species from Surinam included herein, *H. paeminosa*, possess an unusual set of characteristics which justify separation of this species from the remainder of

Western Hemisphere *Hydraena*. The aedeagus (Fig. 95D) has the parameres greatly reduced and attaching near the apex of the main-piece, a trait one might associate with tropical lineages of the genus. However, there is a well developed posterior ridge of the genae similar to that seen in the dominant nearctic lineage (*circulata* Group). The pronotum is most similar to that of *circulata* Group adults, but differs in that it is widest before midlength instead of at or near midlength. Finally, the elytral punctures are well developed and totally random, a condition absent from *circulata* Group adults.

95. *Hydraena paeminosa* new species
(Figs. 95D,160)

Type-locality. – Carolina Creek, 10 kilometers from Zanderij, Surinam.

Type-specimens. – The holotype male and allotype with identical data are deposited in USNM. Paratypes from same locality are deposited in USNM (5 males) and PDP (1 male, 1 female). These specimens were collected by Borys Malkin, November 18, 1962. Additional paratypes (2 males, 2 females) with the following data are also deposited in USNM: Krakka-Phedra Rd., Surinam, November 25, 1962, B. Malkin.

Diagnosis. – Coarsely punctate, markedly microreticulate pronotum which is rather elongate plus the coarse, non-serial elytral punctation serve as diagnostic features for *H. paeminosa*. The intercoxal abdominal sternum is concave and the genae possess a posterior ridge, contrary to the remaining South American *Hydraena* adults.

Description. – *Form:* Elongate. *Size:* Holotype 1.64 mm long, 0.72 mm wide. *Color:* Entirely dark brown except mentum, maxillary palpi and antennae brown. *Head:* Length 0.22 mm. Width 0.40 mm. Frons moderately punctured, interstices with close, fine, impressed lines, surface dull. Frontoclypeal suture arcuate to rear. Clypeus microreticulate. Labroclypeal suture arcuate in dorsal aspect. Labrum bilobed, microreticulate, each lobe symmetrical arc; median emargination wide, ended slightly above midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.32/0.16/0.22; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 extremely slender in basal 0.33, apical 0.66 lateral surface slightly arcuate, median surface slightly more arcuate; palpomere 4 widest near apical 0.33. Mentum wider than long, surface moderately shining, finely punctulate. Submentum finely punctulate, somewhat inflated. Genae dull; lateral area of each gena with well developed foveola; posterior ridge well developed. Postgena with punctation slightly larger than that of submentum. Last five antennomeres pubescent. Eyes 0.25 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (slightly posterior to midlength) 0.50 mm; sides margined, denticulate; sides relatively slightly produced at middle, concave and slightly convergent to anterior and posterior angles, anterior border 0.44 mm wide, straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.46 mm wide, slightly arcuate to rear. Posterointernal foveolae absent. Posteroexternal and anteroexternal foveolae confluent, in form of explanate sides of pronotum. Disc dull, punctures moderately large and close together, interstices microreticulate; surface dull; most punctures with seta extended above cuticle in dry specimens. Scintilla absent. Prosternum carinate, carina produced anteriorly as very short spine, width of carina between coxae three times width of carina anterior to coxae; carina sinuate line in lateral aspect. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina extended to base of intercoxal process; intercoxal process relatively narrow, sides nearly parallel, apex rounded, width near apex slightly less than 0.50 distance between internal and median carinae, subequal distance between procoxae. Metasternum with median ridge posterior to intercoxal process, ridge ended near anterior region of plaques; plaques well developed, straight, somewhat triangular, convergent moderately from posterior to anterior; plaques 0.57 length of metasternum in midline; greatest width of each plaque subequal width of intercoxal process at its midlength; plaques separated posteriorly by approximately plaque width; plaques flat in cross section. Excavation posterior to middle coxal cavities well developed. *Elytra:* Length 1.10 mm. Maximum width (at midlength) 0.72 mm. Punctures large, close together and random; interstices somewhat uneven; surface dull; most punctures with seta. Explanate margin quite narrow, ended near posterior 0.20, with extremely fine serrations near apices. Elytral apices, in dorsal aspect, gradually rounded; in posterior aspect, elytral margin elevated very slightly, obliquely toward suture, in form of weak angle wih opposite elytron. *Abdomen:* Intercoxal segment concave; posterior margin arcuate. Glabrous segments at apex not produced, flat, width twice length. Segment 7 without emargination at apex. *Legs:* Protibia slightly arcuate.

Mesotibia slightly constricted at base, with conspicuous pubescence. Metatibia very slightly expanded on inner surface near apical 0.33. *Genitalia:* Aedeagus as illustrated (Fig. 95D)(9 examined).

Natural History. – The label notation, "waterholes from drying up forest stream with gravelly bottom" accompanies the specimens from the type-locality.

Distribution. – (Fig. 160). Presently known only from Surinam, near Zanderij.

Etymology. – Latin, *paeminosa* (uneven, rough). This name refers to the dull dorsal surface, which is coarsely punctate and markedly microreticulate, especially on the pronotum.

GENUS *SPANGLERINA*, NEW GENUS

Type of the genus: *Spanglerina ingens*, new species. Gender:feminine.

Discussion. – This new genus is erected for four species of Central American hydraenines whose adults are unique in several external characteristics, both dorsal and ventral, aedeagal structure, and habitat preferences. Adults of *Spanglerina* possess elongate maxillary palpi characteristic of *Hydraena* species, but differ from members of that genus in many respects. Significantly, these differences do not indicate a sister-group relationship with any of the sublineages of *Hydraena* (i.e., *circulata*, *leechi* or *marginicollis* Groups, or the subgenus *Haenydra*), but are a curious mixture of features, some of which characterize the *circulata* Group, some more similar to the *leechi* and *marginicollis* Groups, while several others are unique.

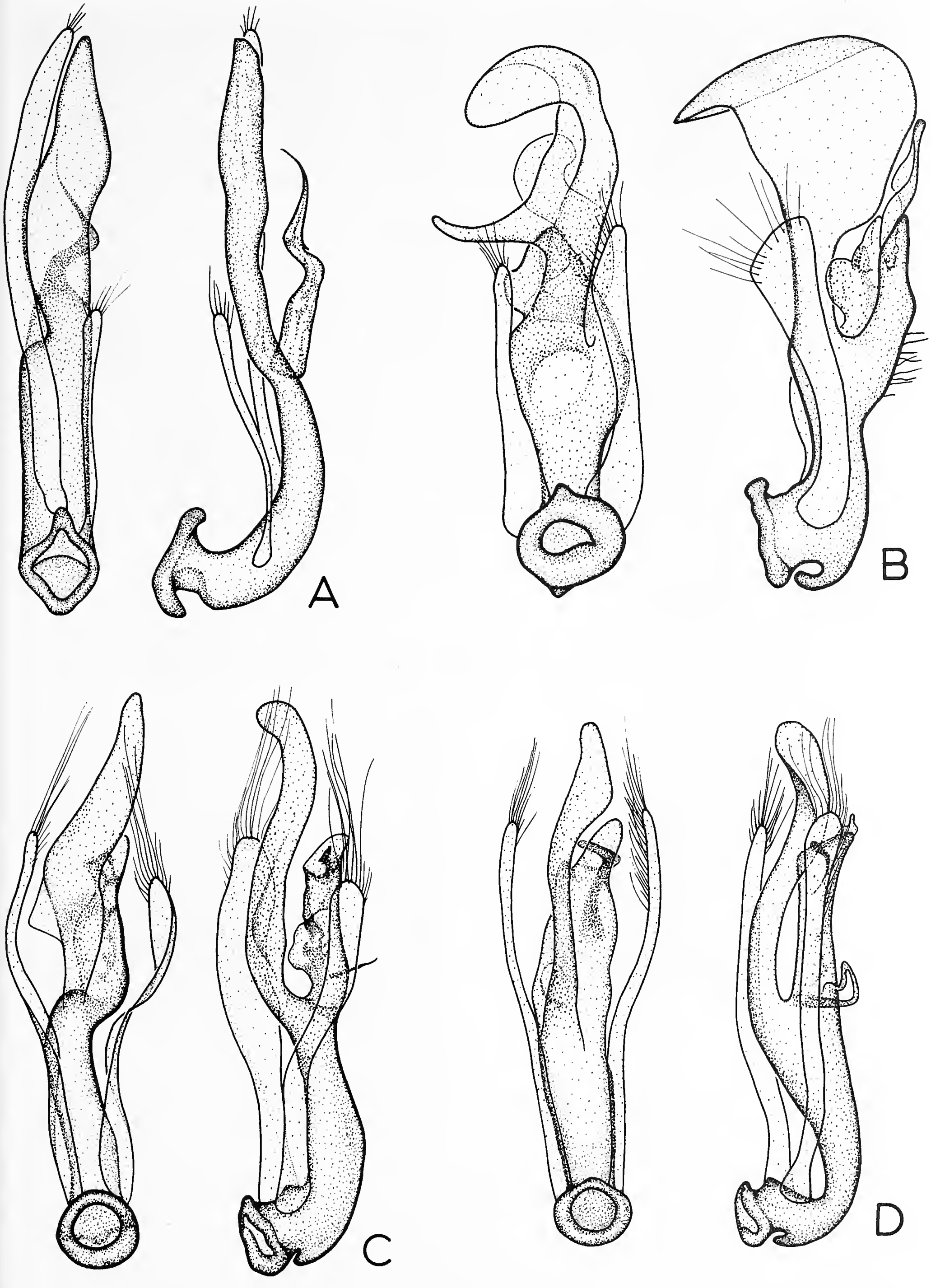
The ventral surface of the head has a well defined genal ridge (Fig. 65D), as do members of the *circulata* Group of *Hydraena*, but the aedeagus (Figs. 67A-D) is extremely complex and the intercoxal segment of the abdomen is flat, features indicative of the *leechi* or *marginicollis* Groups of *Hydraena*. However, although the aedeagus is complex, its basic plan is quite different from any species in the *leechi* or *marginicollis* Groups, having both parameres originating near the base, the left paramere broadly expanded and in form of a large cup in which the complex terminal piece rests. This expanded left paramere possibly provides support to the main-piece and terminal apparatus during copulation, a function unknown in *Hydraena*.

Although the intercoxal sternum of the abdomen is flat, as it is in species of the *leechi* and *marginicollis* Groups of *Hydraena*, it is markedly transverse, more than twice as long as wide, whereas those of *Hydraena* adults are triangular (Figs. 57B,65C) and not as wide.

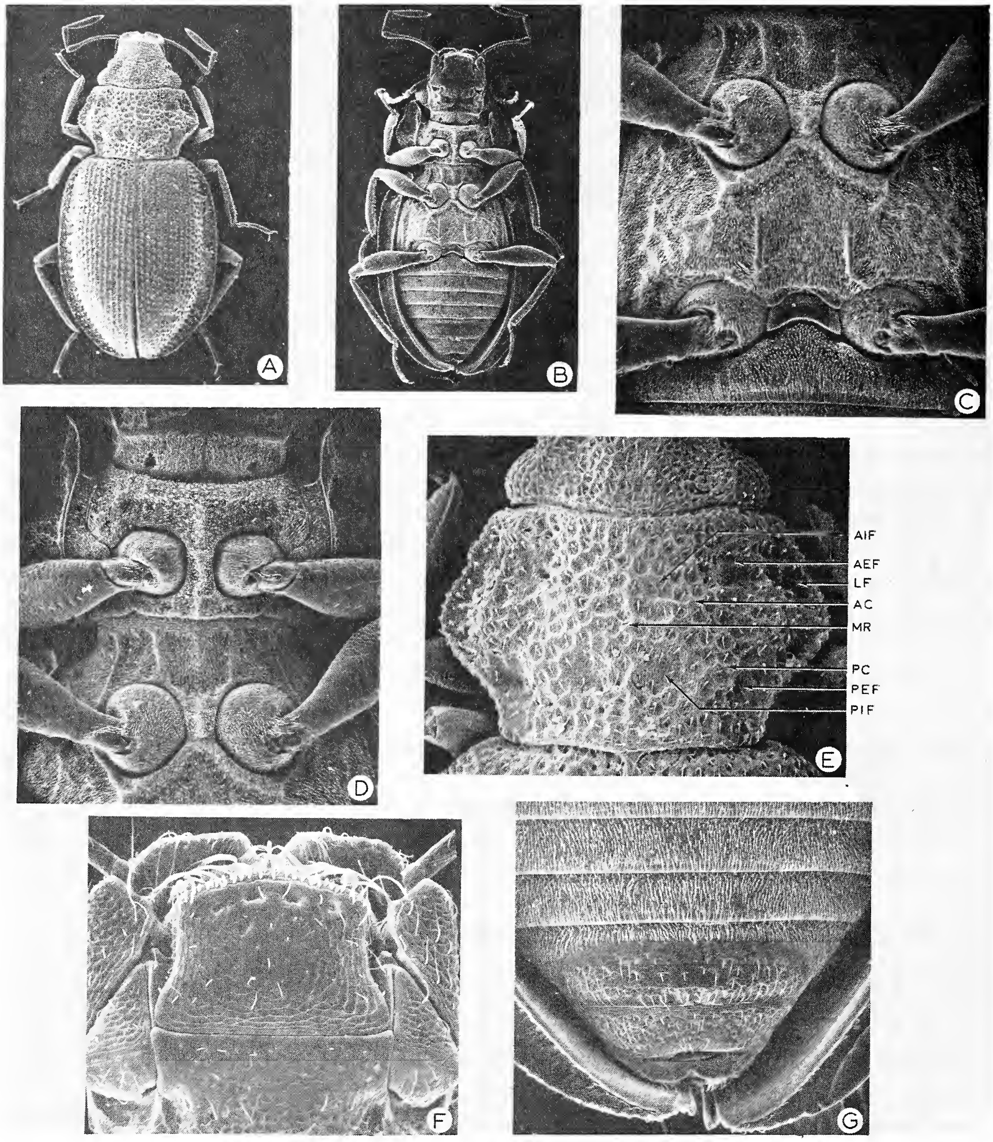
Of course the wide intercoxal sternum of *Spanglerina* is related to the widely spaced hind coxae, but it also is related to another, internal feature which differs from *Hydraena* adults, the form of the metendosternite. In most *Hydraena* adults the metendosternite is "Y" shaped, whereas in *Spanglerina* the "stem" of the "Y" is absent, and the "arms" attach to the base to form a "U" shape.

The widely separated hind coxae are probably related to the unusual habitat preferences of this genus, as are the relatively widely spaced pro- and mesocoxae and the short, dense hydrofuge pubescence (Figs. 65C-D). As discussed in more detail in the "Natural History" section, species of *Spanglerina* are typically found clinging to twigs and other plant debris which become trapped behind emergent rocks in rapid tropical streams. Widely separated coxae are also seen in elmids and presumably enhance a beetle's ability to cling to the substratum in fast water.

This habitat type is quite different from that used by the great majority of *Hydraena* (or the majority of the family, for that matter) which is generally the sand– gravel margins of streams (see Perkins, 1976). An exception to this general rule are the three species of the *geminya*



Figs. 64A – D, Aedeagi of *Hydraena* holotypes. (A) *H. hyalina* (B) *H. vela*. (C) *H. chiapa*. (D) *H. geminya*.



Figs. 65A – G, *Spanglerina brevis*, ♂. (A) dorsal habitus. (B) ventral habitus. (C) metasternum. (D) pro- and mesosternum. (E) pronotum (AIF = anterointernal foveola, AEF = anteroexternal foveola, LF = lateral furrow, AC = anterior callosity, MR = median ridge, PC = posterior callosity, PEF = posteroexternal foveola, PIF = posterointernal foveola). (F) head, ventral aspect. (G) abdominal apex.

Subgroup of *Hydraena*. These three species also have the coxae relatively widely separated (Figs. 63A,F), and I have collected many of them in association with *Spanglerina* individuals while sorting through water–soaked plant debris taken from rapidly flowing tropical streams, brooks and cascades. The habitus and all other characteristics of the *geminya* Subgroup species, however, clearly demonstrate that they are a sublineage of the *marginicollis* Group of *Hydraena*, and that the relatively widely spaced coxae is an indication of convergence with, not relationship to, *Spanglerina*.

Another unusual ventral characteristic is the foveae near the anterior margin of the mentum (Fig. 65F) in *Spanglerina* adults. These foveae have not been seen in any other genus of the Hydraeninae.

Dorsally, *Spanglerina* adults present a distinctive habitus appearance due to the subcordiform pronotum which is markedly produced at the sides, broadly explanate elytra, and rough sculpture (Figs. 65A,E). The pronotum is also unusual in having a slightly elevated median ridge and shallow, rather indistinctly defined anterointernal foveolae. Neither of these features are seen in *Hydraena*.

Consequently, based upon the unusual dorsal, ventral, internal and aedeagal characteristics and habits mentioned above, I conclude that this group represents a phylogenetic lineage separate from and not arising within *Hydraena*, and am therefore affording it equal, generic rank.

Etymology. – I take great pleasure in naming this new genus in honor of Dr. Paul J. Spangler, in recognition of his many and continuing contributions to the knowledge of aquatic Coleoptera.

Pronotal Features. – The major relief features of *Spanglerina* pronota (Fig. 65E) consist of antero- and posterointernal foveolae (AIF and PIF), antero- and posteroexternal foveolae (AEF and PEF), lateral furrows (LF), anterior and posterior callosities (AC and PC), and a median ridge (MR).

Diagnosis. – Adults are readily distinguished from those of *Hydraena*, the only other genus with comparably elongate maxillary palpi, by the widely spaced, rather globose coxae (Figs. 65C-D), and the rough, subcordiform pronotum with low median ridge and indistinctly defined anterointernal foveolae (Fig. 65E). The foveae near the anterior margin of the mentum (Fig. 65F) are also diagnostic.

Description. – *Form:* Ovate, moderately convex (Fig. 65A) *Size:* Length 1.65 -2.00 mm, width 0.80 - 0.97 mm. *Color:* Reddish brown to dark brown, head sometimes bicolored, frons dark brown, clypeus and labrum reddish. *Head:* Coarsely punctate, markedly microreticulate dorsally. Clypeus transverse, sides convergent anteriorly. Labrum bilobed. Maxillary palpus elongate, length of palpomere 2 equal to combined lengths of palpomeres 3 and 4. Mentum rectangular, with four foveae near anterior margin. Genae with posterior ridge. Antennomeres nine (4+5). *Thorax:* Pronotum widely produced at sides, subcordiform, coarsely punctate and markedly microreticulate; disc with well developed posterointernal foveolae, slightly developed anterointernal foveolae and median ridge; postero– and anteroexternal foveolae well developed; groove at sides of pronotum well developed. Prosternum elevated between coxae, latter relatively widely separated. Mesosternum with intercoxal process relatively wide and with slightly elevated median ridge. Metasternum covered with dense, short hydrofuge pubescence, except glabrous, narrow and carinate plaques. *Elytra:* Disc with 10 rows of large punctures between suture and humeral callus, rows striate-impressed. Explanate margin well developed. *Abdomen:* Basal four sterna and anterior portion of fifth with hydrofuge pubescence, remainder with sparse hairs. Intercoxal segment transverse, more than twice as long as wide. *Legs:* Of moderate build. Males with protibia enlarged near apex, metatibia frequently expanded and with brush of hairs. *Genitalia:* Aedeagus with left paramere expanded, partially surrounding terminal piece.

Key to Western Hemisphere species of *Spanglerina*

1 (0) Head unicolorous black; size larger, about 1.72 - 1.92 mm (*ingens* Group) . . . 2

1′ Head bicolored, frons black, clypeus reddish; size smaller, about 1.60 - 1.66 mm (*brevis* Group) 3

2 (1) Posterointernal foveolae less developed, punctures as distinct as those on reliefs; median ridge at anterior and posterior of pronotum, absent from middle; size about 1.92 mm; aedeagus as illustrated (Fig. 67D); Mexico, Mexico . . . . *S. ingens*, new species, p. 216

2′ Posterointernal foveolae more developed, punctures less distinct than those on reliefs; median ridge present for entire length of pronotum; size about 1.72 mm; aedeagus as illustrated (Fig. 67C); Oaxaca, Mexico . . . . *S. fluvicola*, new species, p. 218

3 (1′) Plaques extended further posteriorly; metatibial brush of males less developed, hairs against tibia (Figs. 66C,G); large punctures in posterointernal foveolae more apparent; aedeagus as illustrated (Fig. 67A); Colima, Mexico south to Honduras . . . . *S. brevis* (Sharp), p. 220

3′ Plaques shorter, about 0.50 length of above species (see Fig. 65C); metatibial brush of males well developed, hairs extended from surface of tibia (Figs. 66A-B); punctures in posterointernal foveolae less apparent; aedeagus as illustrated (Fig. 67B); Nayarit and Jalisco, Mexico . . . . *S. frondsicola*, new species, p. 221

The *ingens* Group

Members of this Group are large, about 1.70 - 1.90 mm long, and unicolorous dark brown or black. The metasternal plaques are thin, distinctly elevated, triangular carinae which are widely separated one from the other and situated about midway between the middle and hind coxae. Two Mexican species are currently known for the Group, one from the state of Mexico, the other from Oaxaca. Males have the metatibiae expanded near the apex and with a small brush of hairs (Figs. 66D,E,H-I).

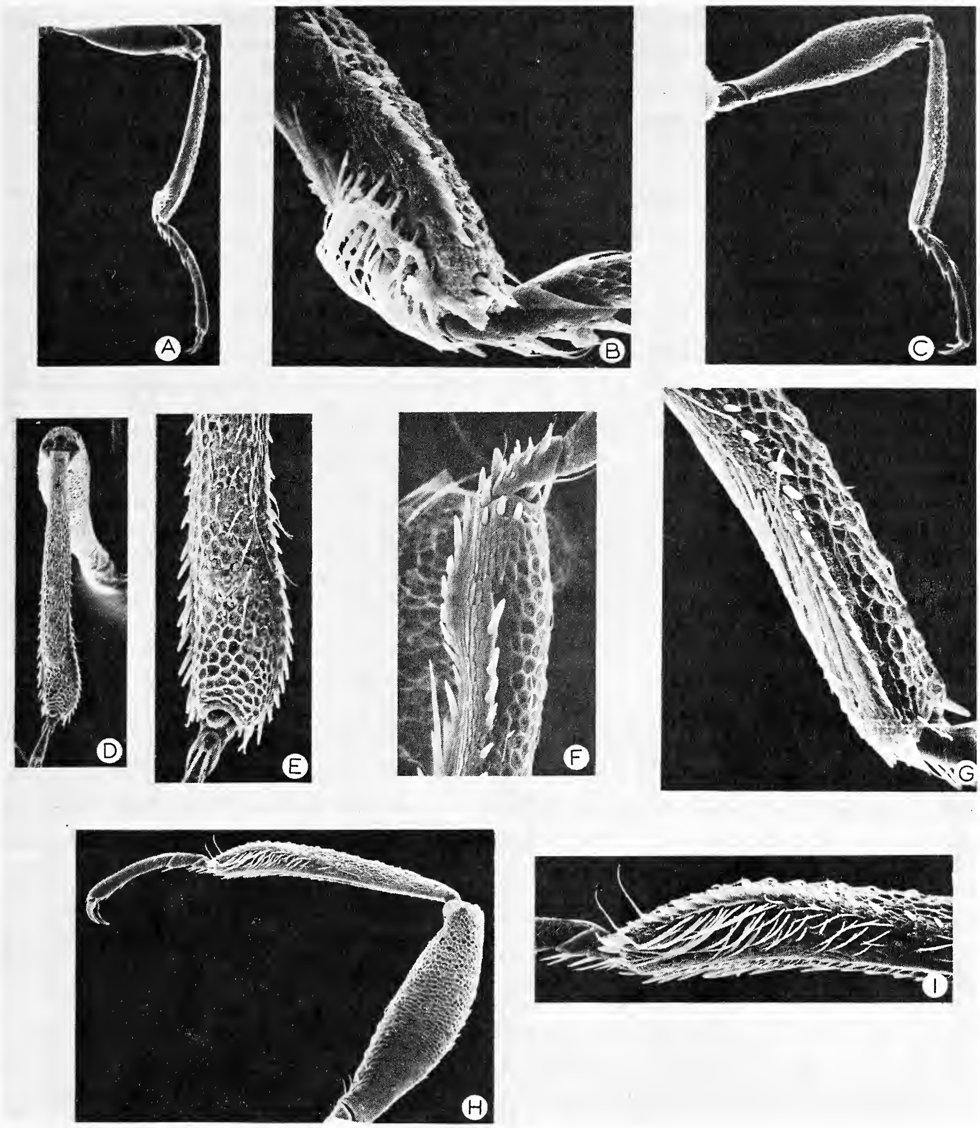
1. *Spanglerina ingens* new species
(Figs. 66D,E,H,I,67D,68A,174,197B)

Type-locality. – Eleven miles S. Valle de Bravo, Mexico, Mexico.

Type-specimens. – The holotype male and allotype with identical data are deposited in USNM. Eight paratypes (6 male, 2 female) with same data are deposited in PDP. These specimens were collected by my wife Maureen and I, July 12, 1974. Two male paratypes (BMNH) have the following data: Mexico, Temescaltepec, Real de Arriba, 6-7000 feet, May, 1933, H. E. Hinton and R. L. Usinger.

Diagnosis. – Distinguished from other members of the genus by large size (1.92 x 0.96 mm), distinctly punctate posterointernal foveolae, broadly explanate elytra, and aedeagal form.

Description. – *Form:* Ovate. *Size:* Holotype 1.92 mm long, 0.96 mm wide. *Color:* Entire dorsal surface dark brown; maxillary palpi light brown. Ventral surface dark brown, except legs, elytral epipleura and abdominal apex, brown. *Head:* Length 0.28 mm. Width 0.48 mm. Frons coarsely punctured: interstices 0.33 puncture diameter, flat and dull;



Figs. 66A – I, *Spanglerina*, legs of males. (A–B) *S. frondsicola*, metathoracic leg. (C) *S. brevis*, metathoracic leg. (D–E) *S. ingens*, metathoracic leg. (F) *S. brevis*, protibia. (G) *S. brevis*, metathoracic leg. (H–I) *S. ingens*, metathoracic leg.

microreticulation extremely fine; deep foveola median to each eye, extended to labroclypeal suture. Frontoclypeal suture recurved, markedly arcuate to rear in midline. Clypeus microreticulate. Labroclypeal suture straight, with clearly defined lateral angles. Labrum bilobed, constricted at base, microreticulate, anterior margin with conspicuous setae; each lobe asymmetrical, sides of median emargination straight, ended well above midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.32/0.12/0.18; palpomere 2 nearly evenly arcuate; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 lateral surface slightly sinuate, with indented portion of sinuation at basal 0.33, median surface arcuate, with apex of curve at basal 0.33, palpomere 4 widest at approximately midlength. Mentum wider than long, with large depressions near anterior margin, otherwise punctulate.

Submentum shining at apex, rugulose at base. Genae moderately shining, with fine punctures; lateral area of each gena with well developed foveola; posterior margin of each gena with ridge. Last five antennomeres pubescent. Eyes slightly less than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.46 mm; Maximum width (slightly before midlength) 0.74 mm; sides not margined, denticulate, markedly produced at middle, slightly arcuate and markedly convergent to anterior angles, arcuate and markedly convergent to posterior 0.17, thence parallel to midline to posterior angles; anterior border 0.56 mm wide, nearly straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.50 mm wide, arcuate to rear; surface with deep punctures and extremely fine microreticulation, latter quite evident on interstices; punctures without perceptible setae; posterointernal foveolae slightly developed, shallow, with punctures as well defined as those on callosities; anterointernal foveolae similar in appearance to posterointernal; posterior callosities moderately developed; anterior callosities very slightly developed; median ridge between internal foveolae, absent from center of pronotum; posteroexternal foveolae clearly developed, separated partially from lateral furrows by lateral callosities; anteroexternal foveolae clearly developed, separated from lateral furrows by narrow ridge. Prosternum slightly carinate, produced to point between coxae, not produced anteriorly as spine; coxae widely separated. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina ended near base of intercoxal process; intercoxal width at apex 0.66 width between internal and median carinae, with median, longitudinal ridge. Metasternum without low ridge posterior to intercoxal process; plaques acute, triangular in lateral view, midway between mid and hind coxae; plaques separated by 0.64 length of metasternum; a shallow furrow lateral to each plaque. *Elytra:* Length 1.26 mm. Maximum width (at midlength) 0.80 mm. Surface moderately dull, disc with 10 rows of deeply impressed punctures between suture and humeral callus, rows very straight; intervals slightly elevated, width 0.66 puncture diameter; interstices between adjacent punctures of row slightly less than interval width; intervals and interstices with various reflections, surface uneven; many punctures with small seta at anterior side (puncture centers obscured by debris). Explanate margin wide, extended to elytral apices, denticulations at anterior angles, remainder with fine serrations. Elytral apices, in posterior aspect, slightly arcuate to ventral surface. *Abdomen:* Intercoxal segment transverse, glabrous. Segment 7 with emargination at apex (male). *Legs:* Protibial median surface slightly arcuate, flat area on posterior surface near apex, with prominent spine at base. Mesotibiae with median surface arcuate at apical 0.66. Metatibia arcuate in apical 0.50, and expanded at apex (Figs. 66D,E,H-I). *Genitalia:* Aedeagus as illustrated (Fig. 67D)(9 examined).

Variation. – The hind tibiae of males (Figs. 66D,E,H-I) have the basal region expanded, slightly arcuate, and bearing a brush of hairs. Females lack these tibial modifications. Additionally, the carinate plaques are distinctively higher in males than in females.

Natural History. – The stream at the type-locality flows through a deciduous-pine forest, and was choked with leaf debris (Fig. 197B). The beetles were found by spreading the wet debris on a cloth and allowing it to dry. Specimens of *Ochthebius obscurus* and *Hydraena scintilla* were also collected at this stream.

Distribution. – (Figs. 68A,174). Presently known only from the state of Mexico, Mexico.

Etymology. – Latin, *ingens* (huge). This name refers to the large size of adults of this species.

2. *Spanglerina fluvicola* new species
(Figs. 67C,68A,174,195B-C)

Type-locality. – One mile N. Ixtlan de Juarez, Oaxaca, Mexico.

Type-specimen. – The holotype male (unique) is deposited in USNM. My wife and I collected this specimen August 5, 1974.

Diagnosis. – Quite similar in most respects to *S. ingens* adults, but smaller (1.72 vs 1.92 mm), and with the pronotum less produced at the sides. Depressions of the pronotum are markedly microreticulate, obscuring the punctation, whereas large punctures are quite evident on the reliefs. In *S. ingens* adults the punctures are equally evident in the depressions and on the reliefs. The metatibiae of *S. fluvicola* adults are of a similar shape to those of *S. ingens* (Figs. 66D,E,H-I), but apparently lack the brush of hairs present on the latter. The aedeagi of males of the two species (Figs. 67C-D) are of a different form.

Description. – *Form:* Ovate. *Size:* Holotype 1.72 mm long, 0.84 mm wide. *Color:* Dorsal surface with head dark brown, nearly black; pronotum dark brown except lighter areas at anterior and posterior borders; elytra brown except

explanate margin light brown. Maxillary palpi testaceous. Ventral surface dark brown except legs, elytral epipleura and anterior region of mentum brown. *Head:* Length 0.28 mm. Width 0.44 mm. Frons coarsely punctured; interstices 0.33 puncture diameter, flat and dull; microreticulation extremely fine; deep foveola median to each eye, extended to labroclypeal suture. Frontoclypeal suture recurved, markedly arcuate to rear in midline. Clypeus microreticulate. Labroclypeal suture straight, with well defined lateral angles. Labrum bilobed, constricted at base, microreticulate; anterior margin with conspicuous setae; each lobe asymmetrical, sides of median emargination straight; median emargination ended above midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.28/0.10/0.24; palpomere 2 nearly evenly arcuate; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface slightly sinuate, indented portion of sinuation at basal 0.33, median surface arcuate, apex of curve at basal 0.33; apical segment widest at approximately midlength. Mentum subquadrate, large depressions near anterior margin, otherwise microreticulate. Submentum shining at apex, microreticulate at base. Genae moderately shining, with fine punctures; lateral area of each gena with well developed foveola; posterior margin of each gena with ridge. Last five antennomeres pubescent. Eyes slightly less than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (slightly before midlength) 0.62 mm; sides not margined, denticulate, markedly produced at middle, slightly arcuate and markedly convergent to anterior angles, arcuate and markedly convergent to posterior 0.17, thence parallel to midline to posterior angles; anterior border 0.48 mm wide, nearly straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.42 mm wide, arcuate to rear; surface with large, deep punctures and extremely fine microreticulation, latter quite evident in foveolae; punctures without perceptible seta; posterointernal foveolae well developed, punctures less distinct than those of callosities; anterointernal foveolae less developed than posterointernal, punctures more apparent; posterior callosities well developed; anterior callosities slightly developed; median ridge evident for entire length of pronotum; posteroexternal foveolae well developed, separated partially from lateral furrows by lateral callosities; anteroexternal foveolae well developed, separated from lateral furrows by narrow ridge. Prosternum slightly carinate, produced to point between coxae, not produced anteriorly as spine; coxae widely separated. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina ended near base of intercoxal process; intercoxal width at apex 0.66 width between internal and median carinae, with median, longitudinal ridge. Metasternum without low ridge posterior to intercoxal process; plaques acute, triangular, approximately midway between mid and hind coxae; plaques separated by 0.66 metasternal length in midline; shallow furrow lateral to each plaque. *Elytra:* Length 1.16 mm. Maximum width (at midlength) 0.82 mm. Surface moderately dull, disc with 10 rows of deeply impressed punctures between suture and humeral callus, rows very straight; intervals slightly elevated, width 0.66 puncture diameter; interstices between adjacent punctures of row slightly less than interval width; intervals and interstices with various reflections, surface uneven; many punctures with small seta at anterior side. Explanate margin wide, extended to elytral apices, denticulations at anterior angles, remainder with fine serrations. Elytral apices, in posterior aspect, slightly arcuate to ventral surface. *Abdomen:* Intercoxal segment transverse, glabrous. Segment 7 with emargination at apex (male). *Legs:* Protibial median surface slightly arcuate, flat area on posterior surface near apex, without large basal spine. Mesotibia with median surface arcuate in apical 0.66. Metatibiae arcuate in apical 0.50, and expanded at apex. *Genitalia:* Aedeagus as illustrated (Fig. 67C)(1 examined).

Natural History. – The type-specimen was removed from a small submerged log, which was about two feet below the surface of a rapid stream (Figs. 195B-C).

Distribution. – (Fig. 174). Presently known only from the type-locality at the base of the mountains north of Oaxaca, Mexico.

Etymology. – Latin, *fluvidus* (flowing) plus *icola* (dweller). Named in reference to the habitat of the type-specimen.

The *brevis* Group

Adults of the *brevis* Group are moderate sized, about 1.60 - 1.70 mm long, with the head bicolored, frons dark brown or blackish and clypeus and labrum reddish. Metasternal plaques are elongate carinae (Fig. 65C), not markedly elevated and triangular as in *ingens* Group adults. Males have the metatibiae with a patch of hairs near the distal end which either form a brush (Fig. 66B) or are flat against the leg (Fig. 66G); the metatibia, however, is not expanded to the degree seen in *ingens* Group adults. Two species are now known for the *brevis* Group, one (*S. brevis*) with an extensive distribution in Mexico and Central America, the other (*S. frondsicola*) apparently restricted to Nayarit and Jalisco, Mexico.

3. *Spanglerina brevis* (Sharp)
(Figs. 10H,65A-G,66C,F-G,67A,68B,174,196A-C)

Hydraena brevis Sharp, 1882:94 (lectotype female deposited in BMNH, herein designated; new combination; type-locality: San Joaquin, Baja Verapaz, Guatemala).

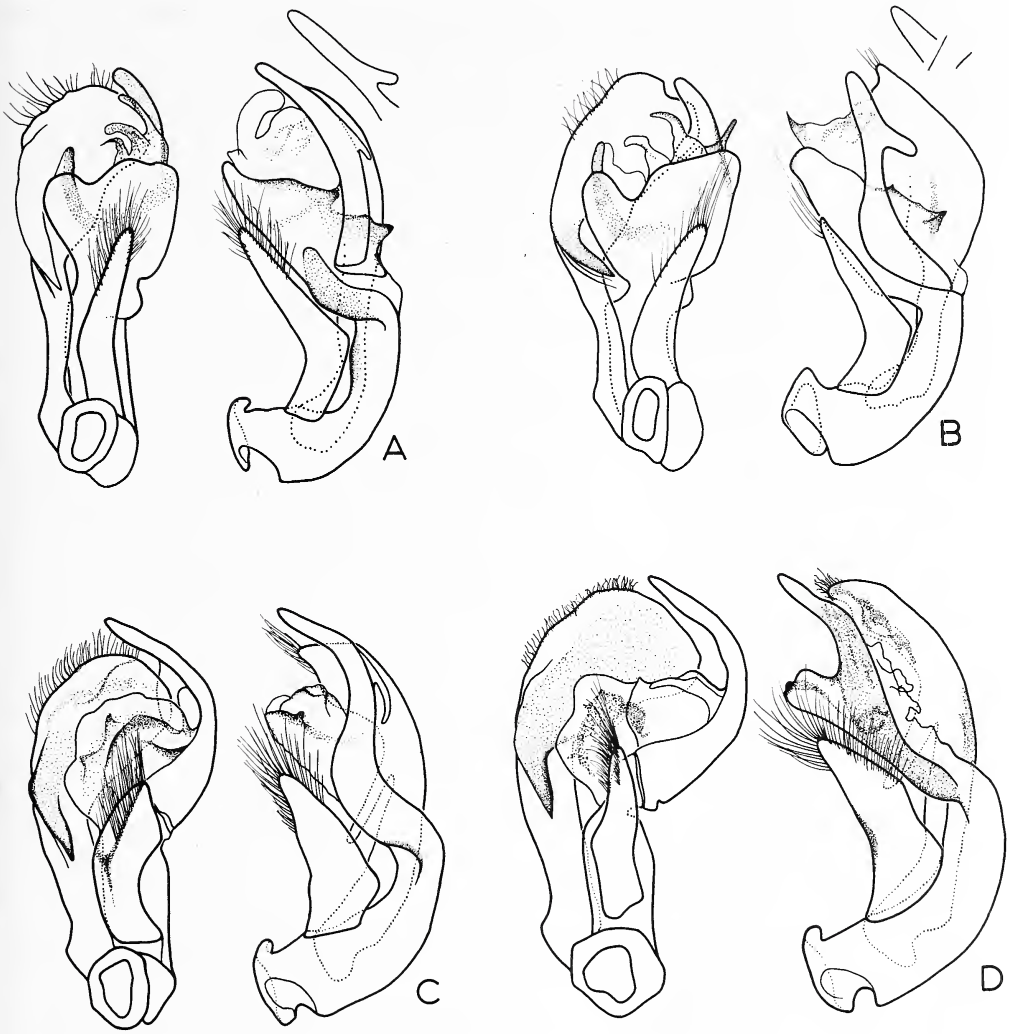
Diagnosis. – Differs from *S. frondsicola*, the only other member of the *brevis* Group, by the longer plaques and aedeagal form. Additionally, the metatibial brush of males (Figs. 66A-C,G) is different in the two species; in *S. brevis* adults, the brush is less developed, hairs against the tibia, whereas in *S. frondsicola* adults, the hairs are more apparent, extended away from the surface of the tibia.

Description. – *Form:* Ovate. *Size:* Lectotype 1.66 mm long, 0.80 mm wide. *Color:* Head bicolored, frons dark brown, clypeus reddish brown; labrum bilobed; maxillary palpi light brown; antennae light brown. Pronotum and elytra brown, slightly reddish. Ventral surface reddish brown. *Head:* Length 0.24 mm. Width 0.42 mm. Frons coarsely punctured, interstices flat, slightly less than puncture diameter; deep foveola median to each eye, extended to labroclypeal suture. Frontoclypeal suture recurved, markedly arcuate to rear in midline. Clypeus microreticulate. Labroclypeal suture straight, with well defined lateral angles. Labrum bilobed, constricted at base, microreticulate, each lobe asymmetrical, side of median emargination straight; median emargination ended slightly above midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.28/0.10/0.20; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface slightly arcuate, apex of arc near apical 0.66, median surface evenly arcuate; palpomere 4 widest at approximately midlength. Mentum wider than long, with large depressions near anterior margin, otherwise microreticulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior margin of each gena with ridge. Last five antennomeres pubescent. Eyes slightly less than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (before midlength) 0.58 mm; sides not margined, coarsely denticulate; sides markedly produced at middle, slightly arcuate and convergent to anterior angles, slightly arcuate and markedly convergent to posterior 0.17, thence parallel to midline to posterior angles; anterior border 0.44 mm wide, nearly straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.42 mm wide, arcuate to rear; surface with large, deep punctures and microreticulation, latter quite evident on interstices; many punctures with short, fine seta; posterointernal foveolae well developed, with punctures less evident than those on callosities; anterointernal foveolae well developed, with some punctures confluent; anterior and posterior callosities well developed, quite rounded; median ridge evident for entire length of pronotum; posteroexternal foveolae well developed, confluent with lateral furrows; anteroexternal foveola well developed, separated from lateral furrow by narrow ridge. Prosternum very slightly carinate, produced to point between coxae, not produced anteriorly as spine; coxae widely separated. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina ended near base of intercoxal process; intercoxal process width at apex subequal to distance between internal and median carinae, with median, longitudinal ridge. Metasternum with low ridge posterior to intercoxal process; plaques extended from near hind coxae to anterior 0.56 of metasternum, separated by 0.50 length of metasternum; furrow lateral to each plaque. *Elytra:* Length 1.06 mm. Maximum width (at midlength) 0.80 mm. Surface dull, disc with 10 rows of deeply impressed punctures between suture and humeral callus; rows very straight; intervals slightly elevated, width 0.50 puncture diameter, as are interstices between adjacent punctures of row; intervals and interstices with various reflections, surface uneven; each puncture with short seta at its anterior side. Explanate margin wide, extended to elytral apices, with denticulations at anterior angles, remainder with fine serrations. Elytral apices, in posterior aspect, slightly arcuate to ventral surface. *Abdomen:* Intercoxal segment transverse, glabrous. Segment 7 without emargination at apex (female). *Legs:* Metatibiae of males as illustrated (Figs. 66C,G). *Genitalia:* Aedeagus as illustrated (Fig. 67A)(5 examined).

Natural History. – Adults are typically found on leaves, twigs and other plant debris trapped behind stones and boulders in rapid tropical streams (Figs. 196A-C).

Distribution. – (Figs. 68B,174). From the state of Colima, Mexico, south to Honduras.

Remarks. – Only five of the 232 specimens studied (see appendix) were males, suggesting that perhaps *S. brevis* is facultatively parthenogenetic.



Figs. 67A – D, Aedeagi of *Spanglerina* species. (A) *S. brevis*, specimen from Oaxaca, Mexico. (B) *S. frondsicola*, holotype. (C) *S. fluvicola*, holotype. (D) *S. ingens*, holotype.

4. *Spanglerina frondsicola* new species
(Figs. 66A-B,67B,68A,174)

Type-locality. – Eleven miles SW Compostela, Nayarit, Mexico.

Type-specimens. – The holotype male and allotype female with identical data are deposited in USNM. Paratypes from the same locality are deposited in USNM (8) and PDP (15). Additional paratypes (15 PDP) have the following data: Mexico, Jalisco, 18 mi. S. Puerto Vallarta. All of the above specimens were collected by my wife Maureen and I during the month of July, 1974.

Diagnosis. – Adults are very similar to those of *S. brevis*, differing in aedeagal form and some external features which are discussed in the diagnosis of that species.

Description. – *Form:* Ovate. *Size:* Holotype 1.60 mm long, 0.78 mm wide. *Color:* Head bicolored, frons dark brown, nearly black, clypeus reddish brown; labrum reddish brown; maxillary palpi light brown; antennae light brown. Pronotum, elytra and venter reddish brown. *Head:* Length 0.24 mm. Width 0.40 mm. Frons coarsely punctured, some punctures confluent, especially near anterior; deep foveola median to each eye, extended to labroclypeal suture. Frontoclypeal suture recurved, markedly arcuate to rear in midline. Clypeus microreticulate. Labroclypeal suture straight, with well defined lateral angles. Labrum bilobed, constricted at base, microreticulate, each lobe asymmetrical, sides of median emargination straight, ended slightly above midlength of labrum. Maxillary palpus with following lengths (mm) of palpomeres 2, 3 and 4, respectively: 0.28/0.10/0.24; palpomere 2 bent outward at approximately midlength; apices of palpomeres 2 and 3 not especially expanded; palpomere 4 with lateral surface slightly arcuate, apex of arc near apical 0.66, median surface evenly arcuate; palpomere 4 widest near midlength. Mentum wider than long, with large depressions near anterior margin, otherwise microreticulate. Submentum microreticulate. Genae shining; lateral area of each gena with well developed foveola; posterior margin of each gena with ridge. Last five antennomeres pubescent. Eyes slightly less than 0.20 interocular distance in width. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (near midlength) 0.58 mm; sides not margined, coarsely denticulate; sides markedly produced at middle, slightly arcuate and convergent to anterior angles, slightly arcuate and markedly convergent to posterior 0.17, thence parallel to midline to posterior angles; anterior border 0.44 mm wide, nearly straight and nearly perpendicular to midline in lateral 0.25, moderately arcuate to rear in middle 0.50; posterior border 0.42 mm wide, arcuate to rear, surface with large, deep punctures and microreticulation, latter most evident in center of larger punctures; many punctures with short, fine seta, interstices on callosities thin ridges without microreticulation; posterointernal foveolae well developed, without large punctures, but microreticulation very evident; anterointernal foveolae well developed, with some punctures confluent; anterior and posterior callosities well developed, rounded; median ridge evident for entire length of pronotum; posteroexternal foveola well developed, confluent with lateral furrow; anteroexternal foveolae well developed, separated from lateral furrow by a narrow ridge. Prosternum very slightly carinate, produced to point between coxae, not produced anteriorly as spine; coxae widely separated. Mesosternum with internal and external carinae divergent from anterior to posterior; median carina ended near base of intercoxal process; width of intercoxal process at apex subequal to distance between internal and median carinae, with median, longitudinal ridge. Metasternum with low elevation posterior to intercoxal process; plaques reduced to very short, somewhat peaked carinae in midlength of metasternum, separated by 0.50 length of metasternum; furrow lateral to each plaque. *Elytra:* Length 1.06 mm. Maximum width (at midlength) 0.78 mm. Surface dull, disc with 10 rows of deeply impressed punctures between suture and humeral callus, rows very straight; intervals slightly elevated, width 0.50 puncture diameter, as are interstices between adjacent punctures of a row; intervals and interstices with various reflections, surface uneven; each puncture with short seta at its anterior side. Explanate margin wide, extended to elytral apices, with denticulations at anterior angles, remainder with fine serrations. Elytral apices, in posterior aspect, slightly arcuate to ventral surface. *Abdomen:* Intercoxal segment transverse, glabrous. Segment 7 with emargination at apex (male). *Legs:* Protibia expanded near apex. Metatibia with brush of hairs near apex (male). *Genitalia:* Aedeagus as illustrated (Fig. 67B)(7 examined).

Natural History. – Most of the specimens from the type-locality were removed from water-soaked leaves of Cecropia trees. These leaves had become trapped behind rocks in a moderately swift tropical stream.

Distribution. – (Figs. 68A,174). Presently known from the states of Nayarit and Jalisco, Mexico.

Etymology. – Latin, *frondis* (foliage) plus *icola* (dweller). This epithet refers to the microhabitat of *S. frondsicola*.

GENUS *LIMNEBIUS* LEACH

Limnebius Leach, 1815 (type-species: *Hydrophilus nitidus* Marsham). – Casey, 1900:51-53. – d'Orchymont, 1932b: 657-665. – Brown, 1932:5-6. – d'Orchymont, 1938b:275-291. – d'Orchymont, 1945b:1-24. – Leech and Chandler, 1956:332. – J. Balfour-Browne, 1956:103-107. – F. Balfour-Browne, 1958:131-142.

Limnocharis Horn, 1872 (type-species: *Limnocharis piceus* Horn). – Horn, 1872:144-145. – Casey, 1886:167-171.

Discussion. – Adults of *Limnebius* are distinctive within the Hydraenidae, the body form (Fig. 69A) with its more-or-less evenly arcuate sides and lack of pronotal foveae resulting in a facies quite different from adults of other genera. The facies, in fact, is more similar to that of hydroscaphids, certain ptiliids, primitive staphylinids and phalacrids than to the remainder of

the hydraenids, an interesting example of convergence.

Limnebius lacks the morphological diversity of *Ochthebius* and *Hydraena*, contains fewer species, and is less widely distributed. However, the number of species placed in *Limnebius*, about 100 worldwide, far surpasses the other, much smaller genera.

The genus is primarily north temperate in distribution, but has some tropical elements. Apparently it is absent from Australia and New Zealand. In the Western Hemisphere it is restricted to North America (including Mexico) and Guatemala, being absent from the remainder of Central America, the Antilles and South America (Fig. 160).

Differences between species of *Limnebius* are generally very subtle, most species reliably differentiated only by referral to the aedeagus. Slight microsculpture differences, such as degree of impression of microreticulation, are often more confusing than helpful, as I have found that they vary considerably within species (see *L. alutaceus*).

J. Balfour-Browne (1956), in a paper on Indian *Limnebius*, expressed the external sameness of the species: "Verbal descriptions, though of little practical use in identifying the species, are appended for most of the species. Dissection and examination of the genitalia is essential for recognition of the species.". I have found this to be true for Western Hemisphere species also, and the brevity of my descriptions reflects the external sameness of the species.

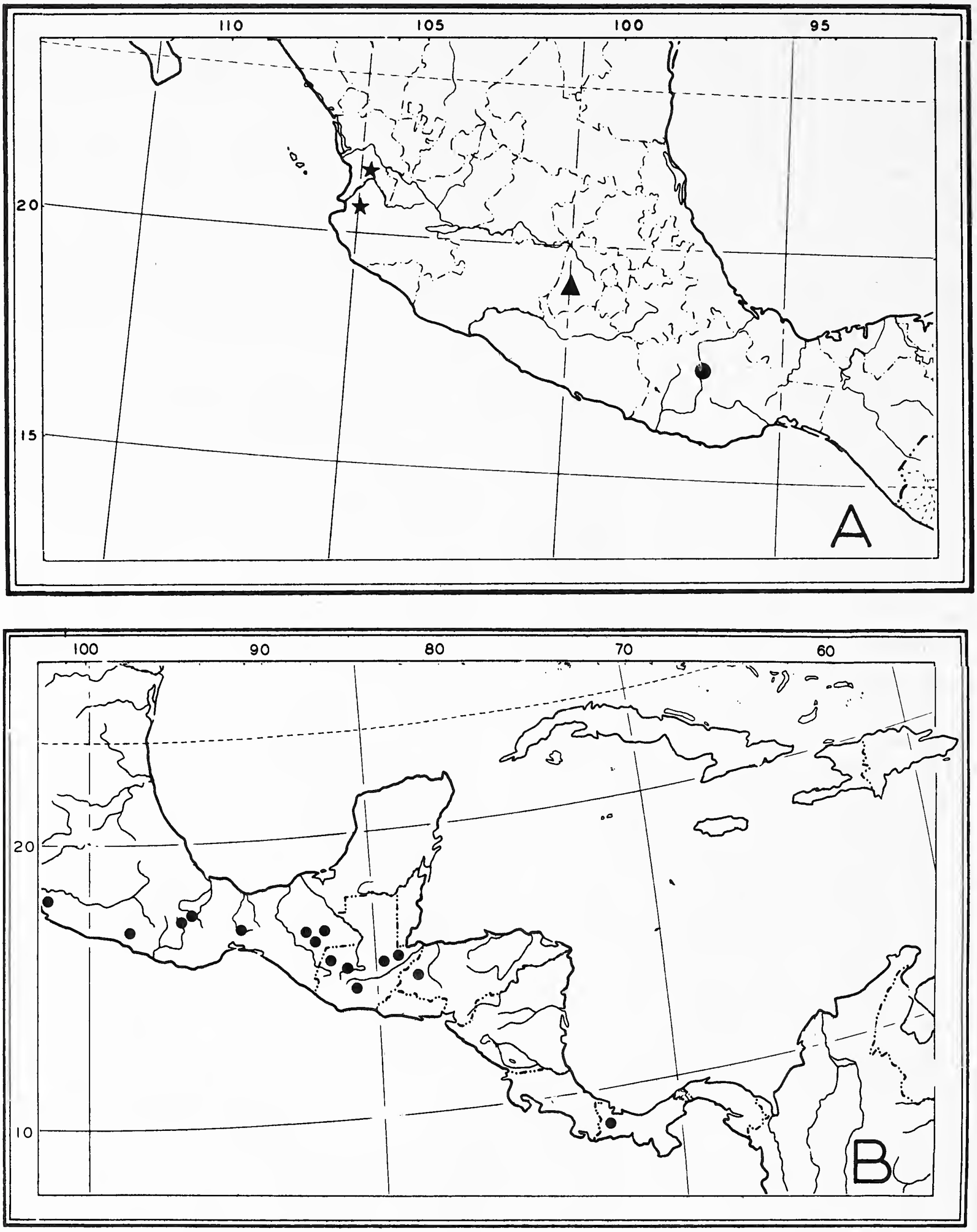
Two subgenera are currently recognized for the genus, *Limnebius* (*sensu stricto*) and *L. (Bilimneus)*, which were redefined by d'Orchymont (1938b) on the basis of presence (sensu stricto) or lack (*Bilimneus*) of parameres. Using this criterion, all of the species in the Western Hemisphere are placed in *Limnebius* (*sensu stricto*) since males have at least some setae on what must be considered modified parameres (Figs. 70,71).

All males have two setae on the "main-piece" of the aedeagus, and there are other setal homologies (cf. Figs. 70,71) which suggest a close relationship between all of the Western Hemisphere species. However, close study of males of non-Western Hemisphere species is necessary to demonstrate that these structures are not widely distributed in the genus.

Two types of aedeagi are represented in the New World fauna, one in which the apical lobe (main-piece) is mobile and more-or-less articulates with the basal portion (Fig. 73C), and one in which these two parts have apparently fused as a single piece (Fig. 73A)(see section on phylogeny for additional comments). Unfortunately, however, external characteristics corresponding to these two aedeagal types are not apparent. Consequently, I have elected not to group the species into morphological aggregates, but to arbitrarily join them into geographical groups in hope of simplifying the task of identification, which should be based upon the aedeagal forms.

The base of the aedeagus is either globose (Fig. 77B) or ovate (Fig. 77A), and in both types it contains a coiled tube (Figs. 70,71). Of the more than 1,000 aedeagi of various species of *Limnebius* that I have studied, a single example of *L. ozapalachicus* has the coiled tube extended (Fig. 75D), and I suspect that most species have the ability to extend this tube during copulation. The rareness of the extended condition in preserved specimens may relate to contraction caused by alcohol in which the beetles are preserved, as I have remarked also concerning the aedeagal tube in *Gymnochthebius*. (Anyway, one would not expect to find the copulatory position in specimens which were preserved during non-copulatory activity). The long duct connecting the spermatheca and bursa copulatrix of *Limnebius* (Fig. 10K) also suggests that this coiled tube is extended during copulation.

Diagnosis. – Easily distinguished from adults of other genera by the evenly arcuate sides of the body (Fig. 69A), lack of pronotal foveae, lack of elytral striae or rows of punctures, and



Figs. 68A – B, Geographical distribution of *Spanglerina* species. (A) *S. fluvicola* ●, *S. frondsicola* ★ and *S. ingens* ▲. (B) *S. brevis*.

proportions of maxillary palpal segments, with palpomeres 2 and 3 subequal in length (Fig. 148D).

Description. – *Form:* Elongate-oval, moderately convex. *Size:* Length 1.15-1.70 mm, width 0.55-0.85 mm. Most females larger than males. *Color:* Most species black, a few dark brown. *Head:* Very finely punctate to alutaceous, very sparsely pubescent. Eyes with antero-dorsal facets effaced. Interocular tuberculi and foveae absent. Labrum shallowly

emarginate, not upturned in either sex. Maxillary palpus moderately long, palpomeres 2 to 4 with approximate ratio of 6:7:8. Antennomeres nine (4+5). *Thorax:* Pronotum with sides arcuate, width at anterior slightly less than that at posterior; foveae absent. Prosternum with coxal cavities open behind. Metasternum pubescent except for small postero-median region. *Elytra:* Finely punctate to alutaceous, striae and serial rows of punctures absent. Males with apices generally more truncate than females. *Abdomen:* Basal five sterna hydrofuge pubescent, last two segments sparsely pubescent, with stout spines laterally. *Legs:* Of moderate length, pro- and mesotarsi with large suction setae in males. *Genitalia:* Aedeagus of many males with setae near midlength, but without distinct parameres; base oval, containing coiled duct.

Key to Western Hemisphere species of *Limnebius*

1 (0) Specimens from the eastern United States west to and including the Ozark Plateau 3

1′ Specimens from western North America or Central America 2

2 (1′) Specimens from the western United States, Baja California, and British Columbia 5

2′ Specimens from Arizona, New Mexico and Texas south to Guatemala 15

3 (1) Males with median depression on abdominal sternum 6. Females with sides of elytra gradually arcuate near apices 4

3′ Males without median depression on abdominal sternum 6. Females with sides of elytra straight near apices; aedeagus as illustrated (Fig. 73D); .... *L. discolor* Casey, p. 227

4 (3) Aedeagus as illustrated (Fig. 72A) .... *L. richmondi*, new species, p. 227

4′ Aedeagus as illustrated (Fig. 75 A-D) .... *L. ozapalachicus*, new species, p. 230

5 (2) Males 6

5′ Females 11

6 (5) Abdominal sternum 6 without median oval depression 7

6′ Abdominal sternum 6 with median oval depression 8

7 (6) Width of head at eyes approximately equal that of anterior area of pronotum, together they form arcuate sides; microreticulation of dorsum less apparent; aedeagus as illustrated (Fig. 72D); California .... *L. leechi*, new species, p. 235

7′ Head narrower than anterior area of pronotum, together they form slightly emarginate sides; microreticulation more apparent; aedeagus as illustrated (Fig. 73B); Utah .... *L. utahensis*, new species, p. 236

8 (6′) Abdominal sternum 6 with tuft of hairs at posterior margin of median oval depression; microreticulation of dorsum generally more apparent; aedeagus as illustrated (Figs. 79A-B); southern British Columbia and Montana to southern California .... *L. alutaceus* (Casey), p. 230

8′ Abdominal sternum 6 without tuft of hairs at posterior margin of median oval depression; microreticulation of dorsum generally less apparent 9

9 (8′) Elytra brown, legs orange-brown, contrasted with much darker venter; aedeagus as illustrated (Fig. 77B); southern British Columbia to Montana .... *L. borealis*, new species, p. 235

9′ Elytra black, legs dark brown, not distinctively contrasting with venter; Oregon to Baja California 10

10 (9′) Sides of elytra more markedly convergent to posterior, width at posterior less; microreticulation less developed, dorsum more reflective; aedeagus as illustrated (Fig. 75F); northern California to Baja California .... *L. piceus* (Horn), p. 230

10′ Sides of elytra less convergent to posterior, width at posterior greater; microreticulation more developed, dorsum less reflective; aedeagus as illustrated (Figs. 70,73C); northern Oregon to Baja California .... *L. arenicolus*, new species, p. 234

11 (5′) Elytral apices incised at suture, apices more prominent, each elytron with greatest length slightly before suture 12

11′ Elytral apices not deeply incised at suture, together in form of more or less rounded apex 13

12 (11) Elytra wider at posterior, sides slightly angulate near posterior 0.20; microreticulation more apparent, dorsum less reflective; northern Oregon to Baja California .... *L. arenicolus*, new species, p. 234

12′ Elytra narrower at posterior, sides lacking angulation at posterior 0.20; microreticulation less apparent, dorsum more reflective; northern California to Baja California .... *L. piceus* (Horn), p. 230

13 (11′) Elytra brown, legs orange-brown, contrasted with dark venter; southern British Columbia to Montana .... *L. borealis*, new species, p. 235

13′ Elytra black, legs dark brown, not distinctively contrasted with venter 14

14 (13′) Width of head at eyes approximately equal that of anterior area of pronotum, together they form arcuate sides; center of pronotal disc non-microreticulate .. .. *L. leechi*, new species, p. 235

14′ Head narrower than anterior area of pronotum, together they form slightly emarginate sides; center of pronotal disc microreticulate .... *L. alutaceus* (Casey), p. 230

15 (2′) Abdominal sternum 6 of males with median oval depression; elytra of females not sinuate before apex 16

15′ Abdominal sternum 6 of males without median oval depression; elytra of females sinuate before apex or not 18

16 (15) Aedeagus as illustrated (Fig. 77D); females with elytra straight slightly before apex; Oaxaca, Mexico .... *L. mexicanus*, new species, p. 243

16′ Aedeagus not as above; females with elytra gradually arcuate to apices 17

17 (16′) Aedeagus as illustrated (Fig. 75E); Texas .... *L. texanus*, new species, p. 241

17′ Aedeagus as illustrated (Fig. 77C); Guatemala .... *L. octolaevis*, new species, p. 243

18 (15′) Aedeagus as illustrated (Fig. 73A); females with elytra sinuate before apex (Fig. 69F); Colorado to Guatemala .... *L. sinuatus* (Sharp), p. 236

18′ Aedeagus not as above; females with elytra not sinuate before apex 19

19 (18′) Aedeagus as illustrated (Fig. 77A); New Mexico .... *L. aridus*, new species, p. 241

19′ Aedeagus not as above 20

20 (19′) Aedeagus as illustrated (Fig. 72C); females with elytra straight slightly before apex; Zacatecas and Nayarit, Mexico. .... *L. mitus*, new species, p. 238

20′ Aedeagus as illustrated (Fig. 72B); females with elytra gradually arcuate to apices; Texas to Tamaulipas, Mexico .... *L. angustulus* (Casey), p. 238

1. *Limnebius discolor* Casey
(Figs. 73D,78B,175)

Limnebius discolor Casey, 1900:52 (lectotype female deposited in USNM, here designated; type-locality: Bennington County, Vermont, U.S.A).

Diagnosis. – Aedeagal form (Fig. 73D) and brownish elytra are the distinctive features of *L. discolor* adults.

Description. – *Form:* Broadest at posterior angles of pronotum; slightly parallel sided. *Size:* Holotype 1.24 mm long, 0.60 mm wide. *Color:* Head black; pronotum brownish at margins, remainder black; elytra and legs brown. *Head:* Finely punctulate, finely microreticulate. *Pronotum*: Finely punctulate; microreticulation of lateral areas as apparent as that on head, slightly reduced on disc. *Elytra:* microreticulation more apparent than that on head. Apices moderately truncate. *Abdomen:* Sternum 6 with very shallow, oval median impression. *Genitalia:* Male (Fig. 73D)(101 examined).

Variation. – Females have the elytral apices acute, the sides just before the apex being rather distinctively straight.

Natural History. – A long series of *Limnebius* was collected from the margins of a small stream in Virginia (Fig. 193B). The substratum consisted primarily of flat slate fragments that were quite small and well worn. I dissected all 106 males from that collection, and found 92 *L. discolor*, 11 *L. ozapalachicus* and 2 *L. richmondi.* This illustrates a phenomenon not infrequently witnessed in this family, that is, extremely low population densities of some species within a sample containing a much more abundant species.

Distribution. – (Figs. 78B,175). Presently known from Missouri, Indiana, Maryland, Virginia, Pennsylvania and Vermont.

Remarks. – Refer to the appendix for detailed locality data. A total of 216 specimens was studied.

2. *Limnebius richmondi* new species
(Figs. 72A,78B,175)

Type-locality. – Roaring Brook, Lowville, Lewis County, New York, U.S.A.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. H. Notman collected these specimens on June 21, 1921. Paratypes consist of two males (PDP) with the following data: 12 mi. S. Williamsville, pebbly stream, Bath County, Virginia, 6-X-73, P.D. Perkins.

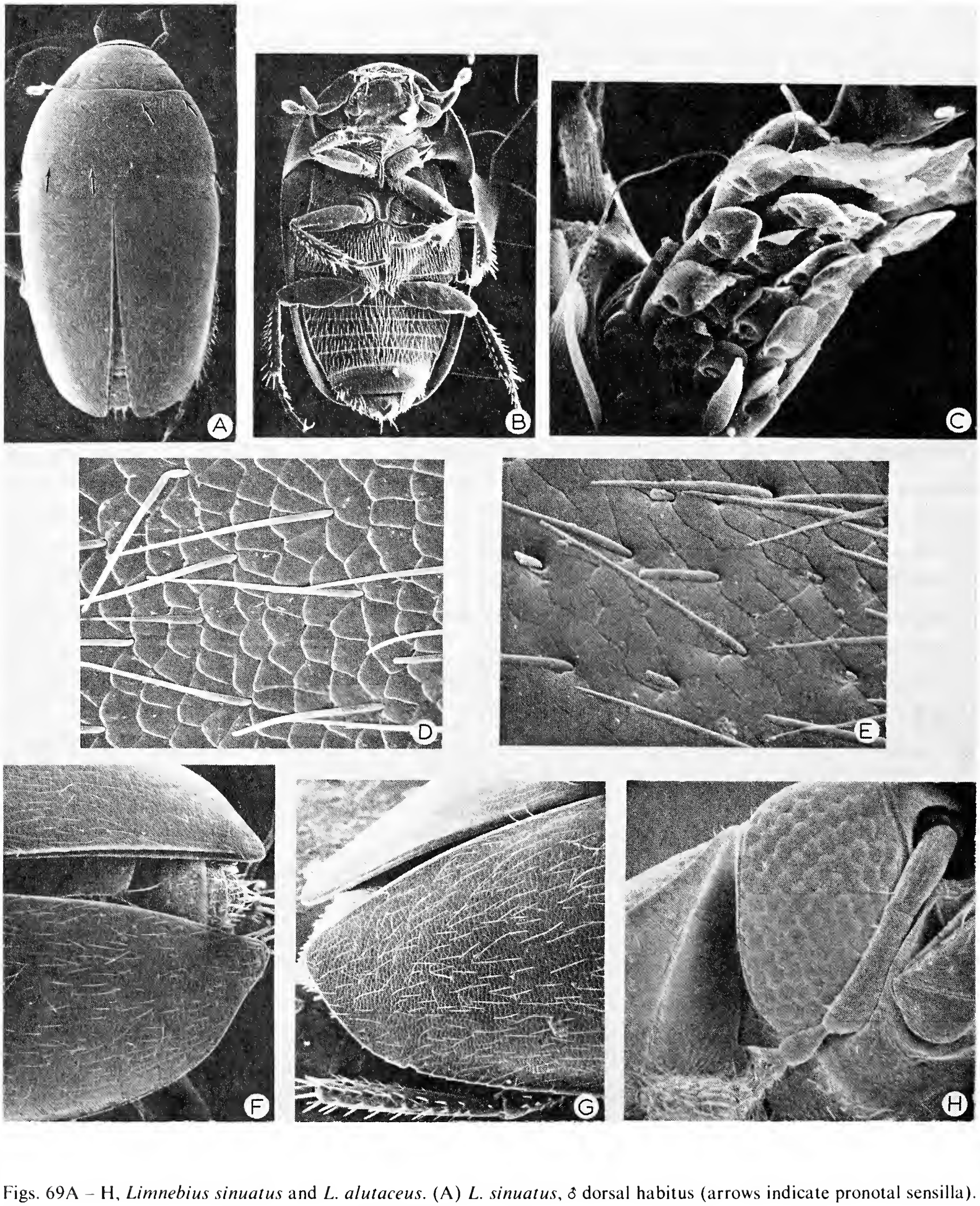
Diagnosis. – Aedeagal form (Fig. 72A), presence of a median depression on the abdominal sternum 6 in males, and brownish elytra in both sexes are distinctive features.

Description. – *Form:* Broadest near posterior angles of pronotum, sides of elytra straight. *Size:* Holotype 1.36 mm long, 0.64 mm wide. *Color:* Head, pronotum and venter black-brown; elytra dark brown; legs brown. *Head:* Finely punctulate, finely microreticulate. *Pronotum*: Finely punctulate, microreticulation as on head laterally, reduced on disc. *Elytra:* Finely punctulate, microreticulation more apparent than that of head; apices truncate. *Metasternum*: Small area in front of hind coxae non-pubescent. *Abdomen:* Sternum 6 with median depression. *Genitalia:* Male (Fig. 72A)(3 examined).

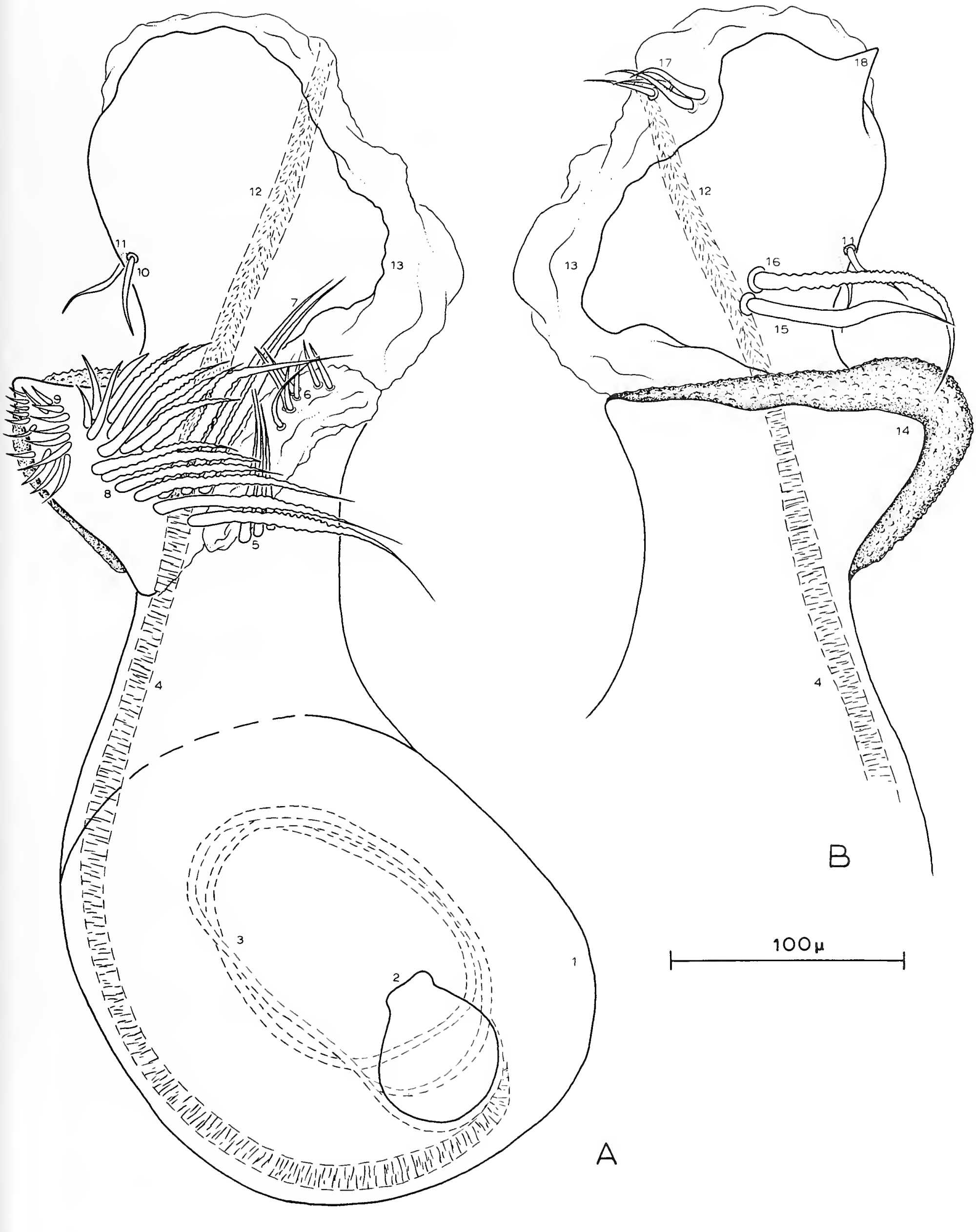
Variation. – Females have the elytral apices arcuate laterally.

Distribution. – (Figs. 78B,175). Appalachian Mountains from Virginia to New York.

Etymology. – I am pleased to dedicate this new species to the late E.A. Richmond, in recognition of his contributions to knowledge of hydraenid and hydrophilid larvae.



Figs. 69A – H, *Limnebius sinuatus* and *L. alutaceus*. (A) *L. sinuatus*, ♂ dorsal habitus (arrows indicate pronotal sensilla). (B) *L. sinuatus*, ♂ ventral habitus. (C) *L. sinuatus*, protarsal suction setae. (D) *L. alutaceus*, microsculpture of elytral disc. (E) *L. sinuatus*, microsculpture of pronotum. (F) *L. sinuatus*, ♀ elytral apices. (G) *L. alutaceus*, ♀ elytral apices. (H) *L. sinuatus*, right eye and antenna.



Figs. 70A – B, Aedeagus of *Limnebius arenicolus*, microslide mount. (A) dorsal aspect. (B) ventral aspect.

3. *Limnebius ozapalachicus* new species
(Figs. 75A-D,78B,175,193B)

Type-locality. – 12 mi. S. Williamsville, Bath County, Virginia, U.S.A.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. I collected these specimens October 6, 1973. Paratypes (300) are listed in the appendix.

Diagnosis. – Aedeagal form (Figs. 75A-D), lack of a median depression on sternum 6 in males, brownish legs and elytra in both sexes, and geographical distribution are distinctive aspects.

Description. – *Form:* Broadest near posterior angles of pronotum, elytra rather straight sided. *Size:* Holotype 1.30 mm long, 0.64 mm wide. *Color:* Head, pronotum and venter black-brown, legs and elytra brown. *Head:* Finely punctulate, finely microreticulate. *Pronotum*: Finely punctulate, microreticulation in lateral areas as on head, reduced on disc. *Elytra:* Finely punctulate, microreticulation more apparent than that of head; apices feebly truncate. *Metasternum*: Small non-pubescent area in front of hind coxae. *Abdomen:* Sternum 6 without median depression. *Genitalia:* Male (Figs. 75A-D)(131 examined).

Variation. – Females have the elytral apices arcuate. The apex of the aedeagus (Figs. 75A-D) is increased in width eastward from the Ozark Plateau and northward in the Appalachian Mountains. The left side (in a morphological sense) tends to become slightly more angulate in the same northward direction, a trend similar to that occurring in the western species, *L. alutaceus.*

Natural History. – Refer to the natural history section of *L. discolor* for comments.

Distribution. – (Figs. 78B,175). Ozark Plateau and Appalachian Mountains of the eastern U.S.A.

Etymology. – Latin adjective, *ozapalachicus*, in reference to the geographical distribution.

4. *Limnebius piceus* (Horn)
(Figs. 75F,76D,175)

Limnocharis piceus Horn, 1872:144 (holotype female deposited in MCZ; type-locality: Fort Crook, California, U.S.A.). Casey, 1886:168. – Casey, 1900:52. – D'Orchymont, 1945:14. – Leech and Chandler, 1956:332.

Limnocharis polita Casey, 1886:168 (lectotype female deposited in USNM, here designated; type-locality: San Francisco, California). – Casey, 1900:52.

Diagnosis. – Aedeagal form (Fig. 75F), presence of a median depression on abdominal sternum 6 of males, and dehiscent elytral apices of females are distinctive characteristics.

Description. – *Form:* Broadest at posterior angles of pronotum, sides feebly arcuate. *Size:* Males about 1.28 mm long, 0.72 mm wide. *Color:* Black. *Head:* Finely punctulate, finely microreticulate. *Pronotum*: Finely punctulate, finely microreticulate laterally, less so on shiny disc. *Elytra:* Finely punctulate, microreticulation slightly more pronounced than that of head; apices truncate. *Metasternum*: Small area in front of hind coxae non-pubescent. *Abdomen:* Sternum 6 with well developed median depression. *Genitalia:* Male (Fig. 75F)(105 examined).

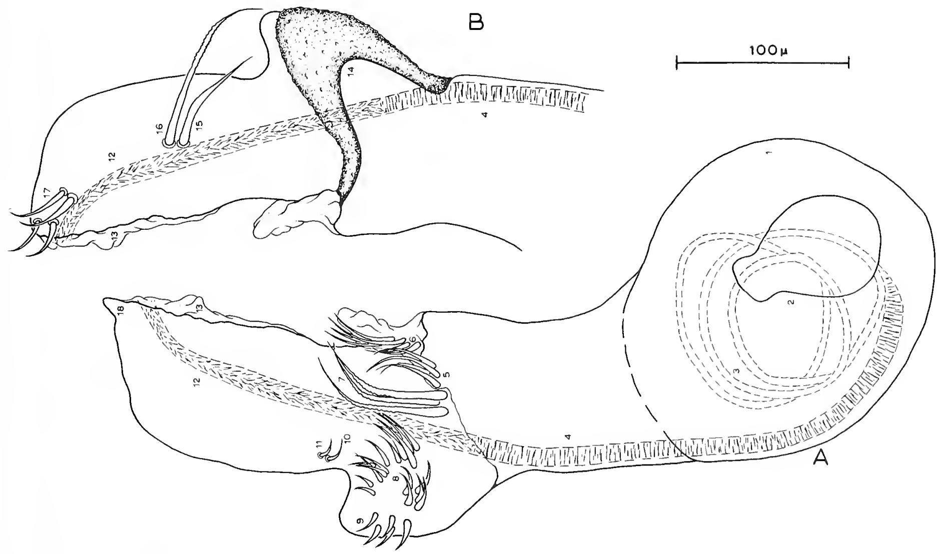
Variation. – Females have the elytra angularly incised at the suture, hence each elytron is longest some distance before the suture.

Distribution. – (Figs. 76D,175). From northern California to northern Baja California.

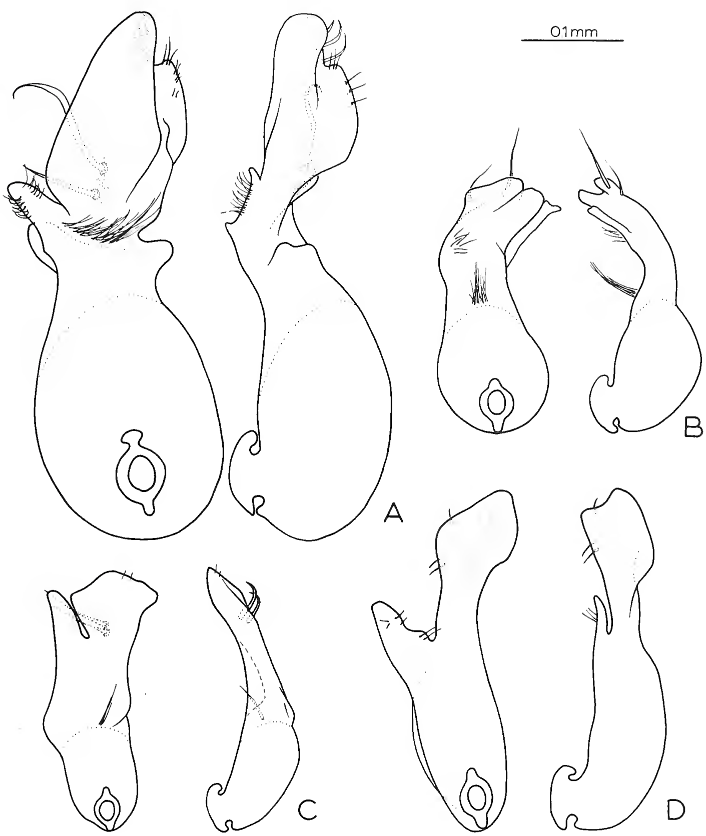
Remarks. – Detailed locality data are given in the appendix; 257 specimens were examined.

5. *Limnebius alutaceus* (Casey)
(Figs. 69D,G,71,76A,79A-B,175)

Limnocharis alutacea Casey, 1886:169 (holotype female deposited in USNM; type-locality: Mendocino County, California). – Casey, 1900:52. – D'Orchymont, 1945:16. – Leech and Chandler, 1956:332.



Figs. 71A – B, Aedeagus of *Limnebius alutaceus*, microslide mount. (A) dorsal aspect. (B) ventral aspect.



Figs. 72A – D, Aedeagi of *Limnebius* species. (A) *L. richmondi*, holotype. (B) *L. angustulus*, specimen from Tamaulipas, Mexico. (C) *L. mitus*, holotype. (D) *L. leechi*, holotype.

Limnocharis congener Casey, 1886:170 (lectotype female deposited in USNM, here designated; type-locality: Mendocino County, California; new synonomy). – Casey, 1900:52.

Limnebius columbianus Brown, 1932:5 (holotype male deposited in CNC; type-locality: Similkameen River, Copper Mt., British Columbia, Canada; new synonomy).

Casey's type-specimen of *congener* and Brown's type-specimen do not differ significantly from Casey's *alutaceus* type-specimen. I have illustrated the aedeagus of Brown's type-specimen (Fig. 79B). Refer to the section on variation for additional comments.

Diagnosis. – Aedeagal form (Figs. 71,79A-B), presence of a median depression on abdominal sternum 6 in males, and well developed anterior pronotal angles in both sexes are distinctive features.

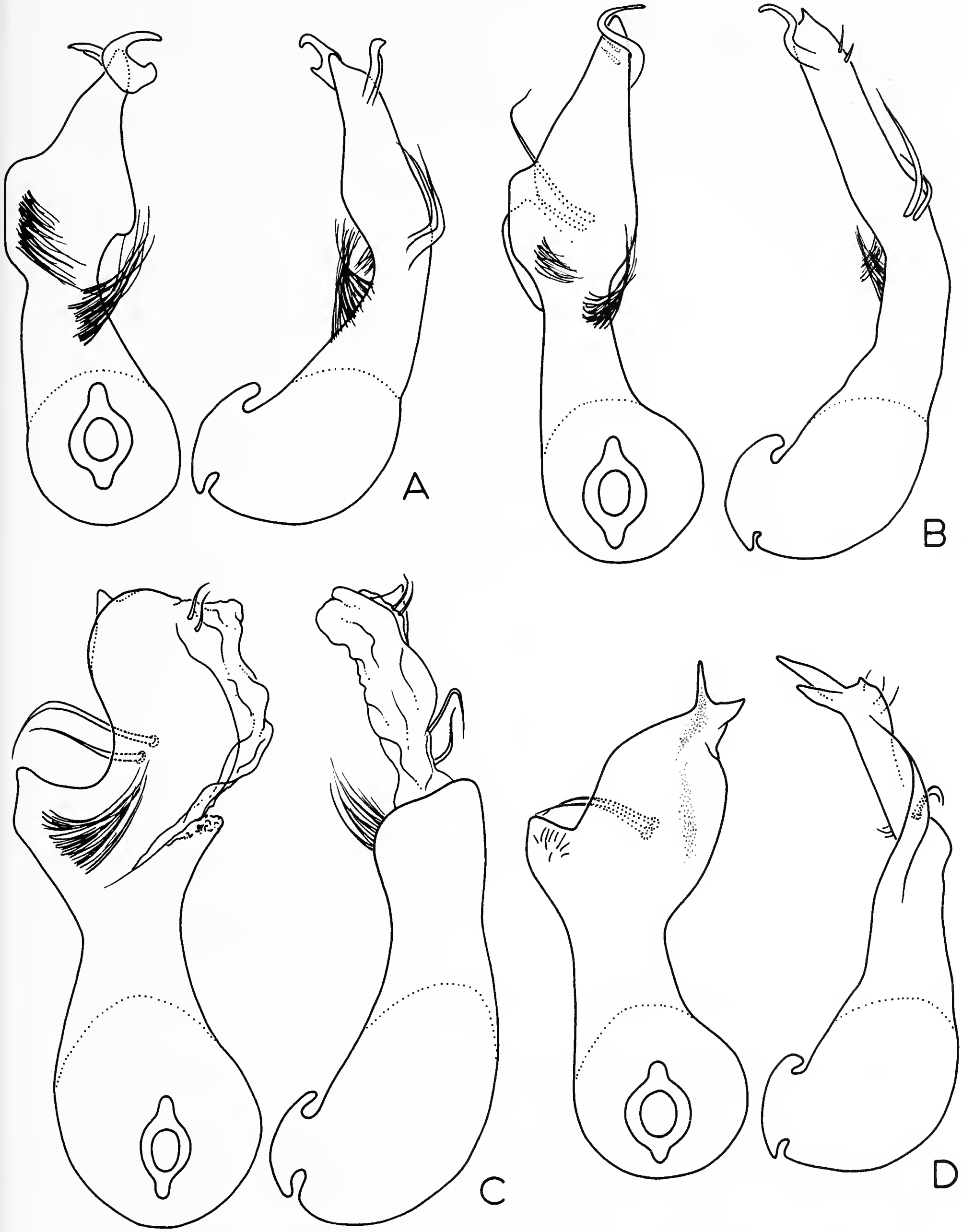
Description. – *Form:* Broadest at posterior angles of pronotum; sides of head forming an angle with pronotum. *Size:* Males about 1.60 mm long, 0.80 mm wide. *Color:* Black. *Head:* Finely punctulate, moderately microreticulate. *Pronotum*: Finely punctulate, moderately to markedly microreticulate laterally, moderately microreticulate on disc. *Elytra:* Finely punctulate, microreticulation similar to that of pronotal lateral areas. *Metasternum*: Small pubescent area in front of hind coxae. *Abdomen:* Sternum 6 with large median depression. *Genitalia:* Male (Figs. 71,79A-B)(202 examined).

Variation. – Specimens are larger on average and more markedly microreticulate northward. Some specimens from the southern extreme of the range have lightly impressed pronotal microreticulation, hence the disc is shiny. By contrast, northern specimens, such as the type-series of *L. columbianus* Brown, have the pronotal disc markedly microreticulate and dull. There is a corresponding difference in the aedeagi from the two areas (Figs. 79A-B). Northern males have the left side (in a morphological sense) decidedly more angulate than southern specimens. Geographically speaking, the two aedeagal forms are most narrowly separated in Idaho (Fig. 76A), where one locality each is known from the counties of Blaine and Lemhi. Only a single male is known from each of these localities, which are about 100 miles apart. The aedeagus of the male from the southernmost of these two localities (Blaine) is clearly of the southern form, whereas the northernmost is clearly of the northern aedeagal form. Since neither of these forms represents an intermediate stage, this might be considered evidence to support a two species hypothesis. However, based upon the morphological gap separating the aedeagi of other species, plus the variation seen within certain species, such as the eastern *L. ozapalachicus*, I am treating these two forms as conspecific. Should future collecting reveal specimens of both aedeagal forms cohabiting, then this position will need to be reversed and *L. columbianus* Brown reinstated. Also, if future collecting in Oregon, Washington and Idaho should demonstrate that the two forms are truly allopatric, then the problem will need reanalysis.

Natural History. – Elsewhere (Perkins, 1976), I have presented some details of microhabitat preferences of *L. alutaceus* in southern California (under the name *Limnebius* Sp. A).

Distribution. – (Figs. 76A,175). Southern British Columbia to southern California.

Remarks. – All of the syntypes of this species in the Casey Collection at the USNM are females. All of the specimens he had identified as *L. piceus* Horn are males of *L. alutaceus*, except one, a male of *L. arenicolus*. He apparently thought that differences in shape of the elytral apices in the two sexes were of a species specific nature. Detailed locality data are given in the appendix; 434 specimens were examined.



Figs. 73A – D, Aedeagi of *Limnebius* species. (A) *L. sinuatus*, specimen from Coconino County, Arizona. (B) *L. utahensis*, holotype. (C) *L. arenicolus*, holotype. (D) *L. discolor*, specimen from Bath County, Virginia.

6. *Limnebius arenicolus* new species
(Figs. 70,73C,76C,175)

Type-locality. – San Gabriel River, West Fork Station, 3100 feet, Los Angeles County, California, U.S.A.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in CAS. I collected these specimens, November 15, 1971. Paratypes (472) are listed in the appendix.

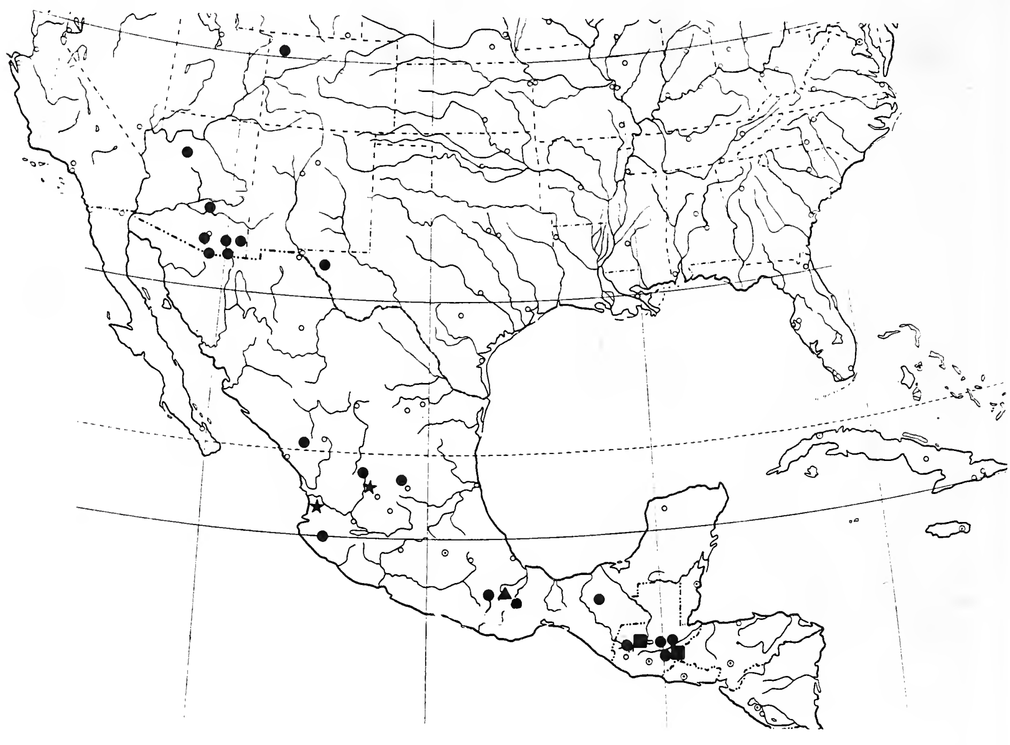


Fig. 74. Geographical distributions of *Limnebius sinuatus* ●, *L. mitus* ★, *L. mexicanus* ▲ and *L. octolaevis* ■.

Diagnosis. – Aedeagal form (Figs. 70,73C) and presence of a median depression on abdominal sternum 6 in males are distinctive features.

Description. – *Form:* Broadest near anterior angles of pronotum, sides of elytra slightly arcuate. *Size:* Holotype 1.40 mm long, 0.72 mm wide. *Color:* Black. *Head:* Finely punctulate, finely microreticulate. *Pronotum*: Finely punctulate, microreticulation laterally as on head, slightly reduced on disc. *Elytra:* Finely punctulate, microreticulation slightly more apparent than that of head. *Metasternum*: Small non-pubescent area in front of hind coxae. *Abdomen:* Sternum 6 with median depression. *Genitalia:* Male (Figs. 70,73C)(261 examined).

Variation. – Females have the elytral apices arcuate laterally.

Natural History. – For some details of the microhabitat preferences of *L. arenicolus*, refer to Perkins (1976), where it is discussed under the name *Limnebius* Sp. B.

Distribution. – (Figs. 76C,175). From northern Oregon to northern Baja California.

Etymology. – Latin, *arena* (sand) plus *colus* (dweller). I refer to the microhabitat of this species.

7. *Limnebius leechi* new species
(Figs. 72D,76B,175)

Type-locality. – McDowell Creek just below Oasis, 1800 feet, Mendocino County, California, U.S.A.

Type-specimens. – The holotype male and allotype with identical data are deposited in CAS. These specimens were collected by Hugh B. Leech, July 27, 1955. Paratypes (54) are listed in the appendix.

Diagnosis. – Aedeagal form (Fig. 72D) and lack of a median depression of abdominal sternum 6 in males are the reliable recognition characteristics of *L. leechi.*

Description. – *Form:* Broadest near anterior angles of elytra; sides feebly arcuate. *Size:* Holotype 1.48 mm long, 0.72 mm wide. *Color:* Black *Head:* Finely punctulate, finely microreticulate. *Pronotum*: Finely punctulate, microreticulate laterally as on head, reduced on disc; pubescence evident. *Elytra:* Finely punctulate, slightly more markedly microreticulate than head; apices truncate. *Abdomen:* Sternum 6 longer than 5, without median depression. *Genitalia:* Male (Fig. 72D)(33 Examined).

Variation. – Females have the elytral apices feebly arcuate.

Natural History. – Habitat descriptors include "seepage trickle over gravelly soil" and "pools in drying bed of Upper Mad River". Of the 17 localities known to date, most are represented by four or fewer specimens, the maximum being 10 specimens. Whether this is an artifact of collecting technique or actually reflects very low population density remains to be clarified.

Distribution. – (Figs. 76B,175). California, principally in the coastal mountain ranges.

Etymology. – I am pleased to dedicate this species to Hugh. B. Leech in recognition of the many specimens which have been available to this study due to his excellent field work.

Remarks. – D'Orchymont (1945b) mistakenly illustrated the aedeagus of this species under the name *Limnebius congener* (Casey). D'Orchymont had not seen the type-specimens of *L. congener*, which name is here synonomized with *Limnebius alutaceus* (Casey).

8. *Limnebius borealis* new species
(Figs. 76B,77B,175)

Type-locality. – Shuswap River, Enderby, British Columbia, Canada.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in CAS. Hugh B. Leech collected these specimens, October 11, 1946. Paratypes (37) are listed in the appendix.

Diagnosis. – Aedeagal form (Fig. 77B), brown elytra, and presence of a median depression on abdominal sternum 6 in males are distinctive characteristics.

Description. – *Form:* Broadest near anterior angles of pronotum, sides of elytra slightly arcuate. *Size:* Holotype 1.40 mm long, 0.78 mm wide. *Color:* Dorsum and venter dark brown; legs, palpi and elytral epipleura light brown. *Head:* Finely punctulate, microreticulate. *Pronotum:* Finely punctulate, microreticulate. *Elytra:* Finely punctulate, microreticulate; apices truncate. *Metasternum*: Small non-pubescent area in front of hind coxae. *Abdomen:* Sternum 6 with a median depression. *Genitalia:* Male (Fig. 77B)(25 examined).

Variation. – Females have the elytral apices arcuate laterally.

Distribution. – (Figs. 76B,175). Presently known from British Columbia and Montana.

Etymology. – Latin, *borealis* (northern). I refer to the geographical distribution of this species.

9. *Limnebius utahensis* new species
(Figs. 73B,76B,175)

Type-locality. – Wasatch Mountains, Utah, U.S.A.

Type-specimen. – The holotype male (unique) is deposited in CAS. This specimen was collected by O. Bryant, June 28, 1947.

Diagnosis. – Aedeagal form (Fig. 73B), absence of median depression on abdominal sternum 6 in males, quite uniform microreticulation over the entire dorsum, and geographical distribution are distinctive features.

Description. – *Form:* Broadest near anterior angles of elytra, sides of elytra very slightly arcuate. *Size:* Holotype 1.44 mm long, 0.66 mm wide. *Color:* Dorsum and venter black; legs and palpi brown. *Head:* Finely punctulate, moderately microreticulate. *Pronotum:* Finely punctulate, moderately microreticulate. *Elytra:* Finely punctulate, moderately microreticulate; apices truncate. *Metasternum*: Small non-pubescent area in front of hind coxae. *Abdomen:* Sternum 6 without median depression. *Genitalia:* Male (Fig. 73B)(1 examined).

Distribution. – (Figs. 76B,175). Known only from the type-locality in the Wasatch Mountains of Utah.

Etymology. – Latinized adjective, *utahensis*, in reference to geographical distribution.

Remarks. – The holotype has two small but very apparent foveolae on the pronotal disc, one on each side of the midline slightly behind the middle. These foveolae are slightly larger than the marginal foveolae in front of the scutellum. Additional specimens are necessary to confirm the constancy of this characteristic.

10. *Limnebius sinuatus* (Sharp)
(Figs. 3C,10K,11B,69A-C,E-F,H,73A,74,148D,149D,150A-C,152C-D,153F-G,175)

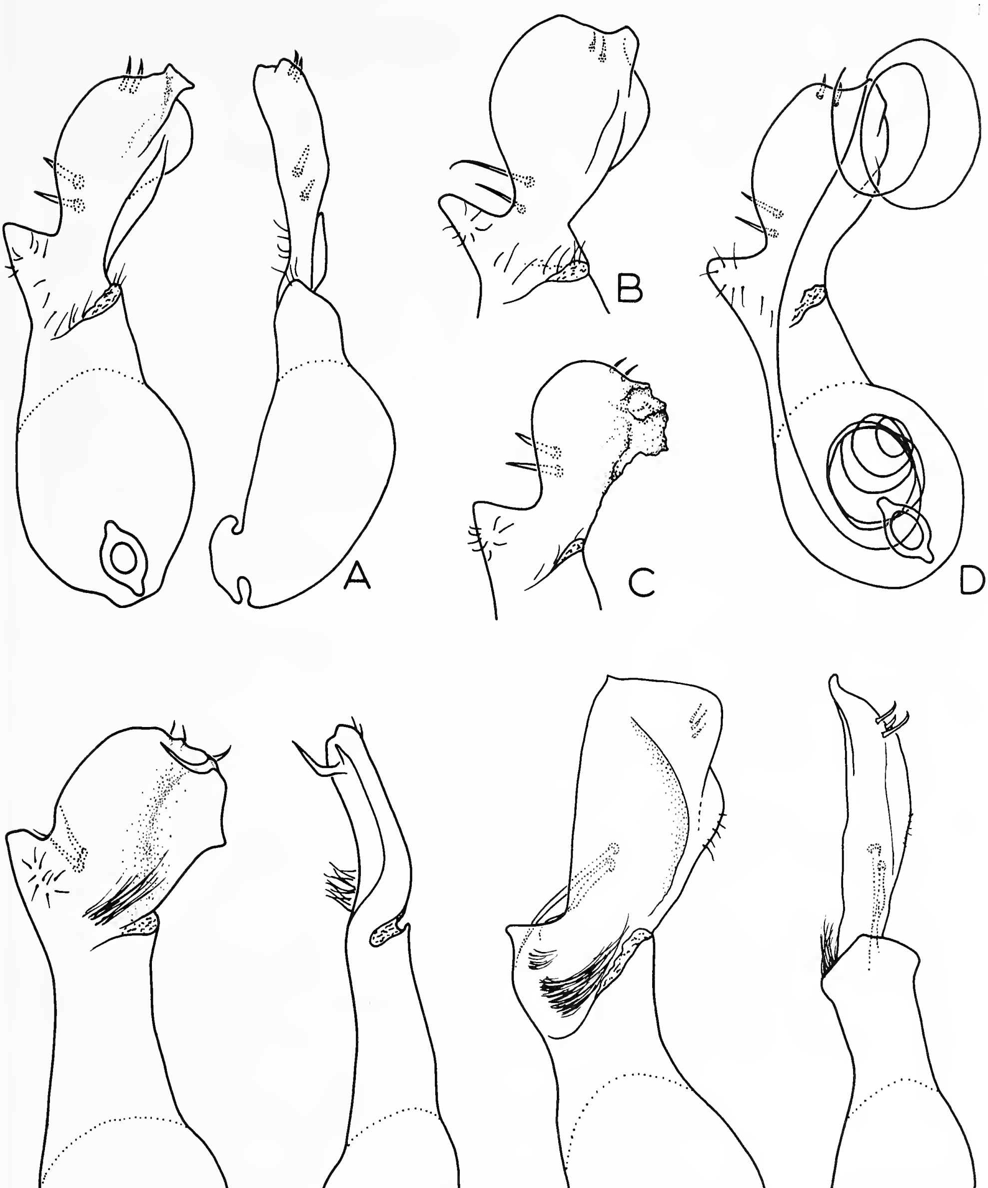
Limnocharis sinuatus Sharp, 1882:86 (holotype female deposited in BMNH; type-locality: San Joaquin, Baja Vera Paz, Guatemala).

Diagnosis. – Aedeagal from (Fig. 73A), absence of a median depression on abdominal sternum 6 in males, sinuate elytral apices in females (Fig. 69F), and a small non-pubescent area on metasternum just in front of hind coxae in both sexes serve as diagnostic characteristics for *L. sinuatus*.

Description. – *Form:* Broadest near anterior angles of elytra; sides feebly arcuate. *Size:* Males about 1.16 mm long, 0.60 mm wide. *Color:* Black. *Head:* Finely punctulate, finely microreticulate. *Pronotum:* Finely punctulate, finely microreticulate laterally, disc non-micoreticulate, shiny. *Elytra:* Finely punctulate, microreticulation more apparent than that of head; apices moderately truncate. *Metasternum*: Glabrous in very small area just anterior to hind coxae. *Abdomen:* Sternum 6 without definite median depression. *Genitalia:* Male (Fig. 73A)(143 examined).

Variation. – Females of this species are unique in having the elytral apices distinctively sinuate just before the apex (Fig. 69F). There is some very slight, non-significant variation in contours of the aedeagal apex; it does not warrant illustration.

Natural History. – This species is relatively common in Guatemala and Mexico, frequently becoming very abundant locally (see appendix). Highest population densities are reached in streams of open habitats, such as pine-oak woodland, but specimens are also found at margins of streams in more arid regions (Fig. 195A). Despite intensive collecting on seepage areas at many localities throughout Guatemala and Mexico (principally in densely vegetated, tropical habitats), I was unable to find a single specimen of *L. sinuatus*. Some of these madicolous



Figs. 75A – F, Aedeagi of *Limnebius* species. (A) *L. ozapalachicus*, holotype. (B) *L. ozapalachicus*, variant from Maine. (C) *L. ozapalachicus*, deformed. (D) *L. ozapalachicus*, specimen from Ohio County, Kentucky with internal tube protruded. (E) *L. texanus*, holotype. (F) *L. piceus*, specimen from Monterey County, California.

(seepage) habitats were a short distance from a sandy stream where *L. sinuatus* adults were found. Perhaps this is a reflection of the strict psammophilous nature of *L. sinuatus*. Further research is needed to verify or reject this suggestion.

Distribution. – (Figs. 74,175). Colorado to Guatemala.

Remarks. – Refer to the appendix for detailed locality data; 623 specimens were examined.

11. *Limnebius angustulus* (Casey) (Figs. 72B,78A,175)

Limnocharis angustula Casey, 1886:168 (holotype female deposited in USNM; type-locality: Austin, Texas, U.S.A.).
Limnocharis coniciventris Casey, 1886:171 (holotype male deposited in USNM; type-locality: Austin, Texas, U.S.A.; new synonomy).

These type-specimens represent the sexes of one species. Casey apparently overlooked the obvious pro- and mesotarsal suction setae of the males in this genus. His name *coniciventris* is a misnomer; the conical shape of the abdomen and very convex elytra are clearly a result of shrinkage, as this specimen is quite teneral. Fully hardened and darkened males have the abdomen shaped as in other species of the genus.

Diagnosis. – Aedeagal form (Fig. 72B), small size and geographical distribution are the distinctive features of this species.

Description. – *Form:* Broadest at posterior angles of pronotum; relatively narrow. *Size:* Males about 1.20 mm long, 0.12 mm wide. *Color:* Black. *Head:* Finely punctulate, finely microreticulate. *Pronotum:* Finely punctulate, very finely microreticulate laterally, disc very shiny, not microreticulate. *Elytra:* Finely punctulate, microreticulation very fine, but more apparent than that on head and pronotum; sides straight, posterior angles well formed, hence apices truncate. *Abdomen:* Sternum 6 without median impression. *Genitalia:* Male (Fig. 72B)(4 examined).

Variation. – Females have the elytra slightly arcuate at rear.

Natural History. – Three males and two females were collected at the margin of a desert stream 2 mi. SW Ciudad Victoria, Tamaulipas, Mexico by my wife Maureen and I, July 27, 1974, at the uppermost reaches of the stream, where the ground water was emerging from the otherwise dry streambed. These specimens plus Casey's two type-specimens are the only known to date.

Distribution. – (Figs. 78A,175). Texas and northeastern Mexico.

Remarks. – The aedeagus illustrated is from a specimen collected at 2 mi. SW Ciudad Victoria. It is virtually identical to that of Casey's *coniciventris* type-specimen; the latter, however, is slightly collapsed due to its teneral condition.

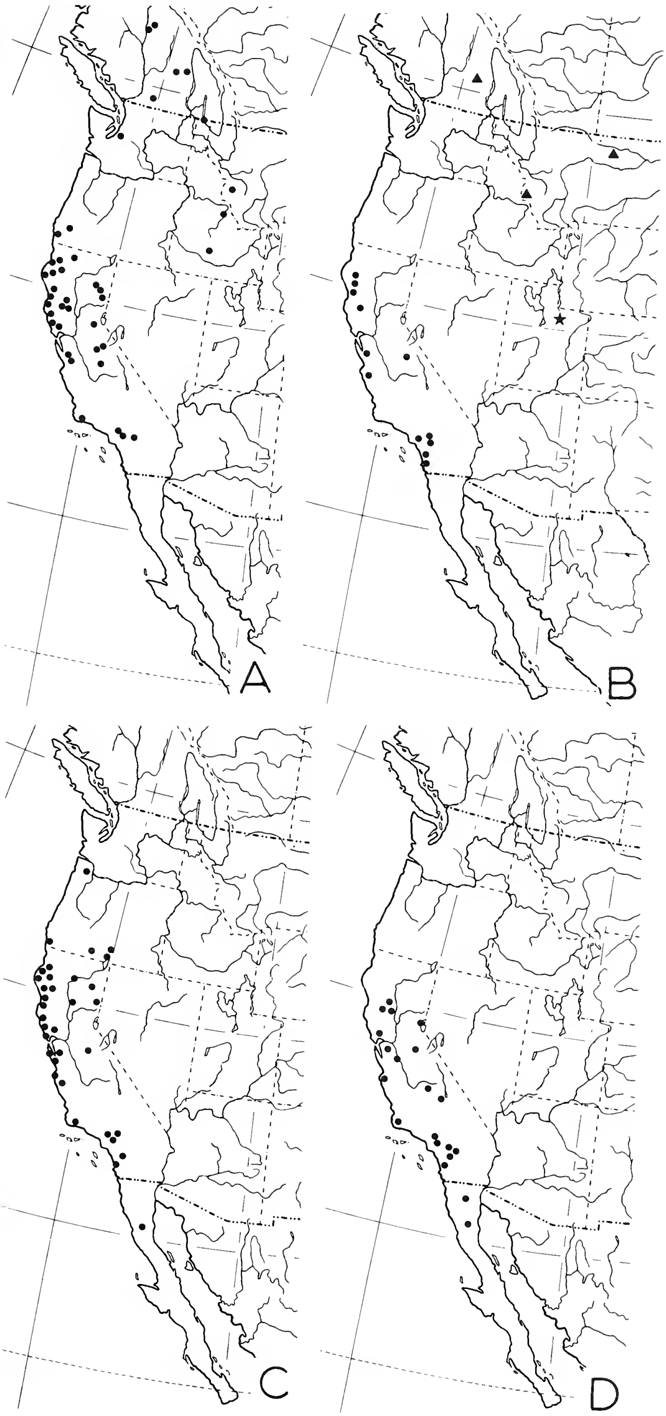
12. *Limnebius mitus* new species (Figs. 72C,74,175)

Type-locality. – 13 mi. S. Jalpa, Zacatecas, Mexico.

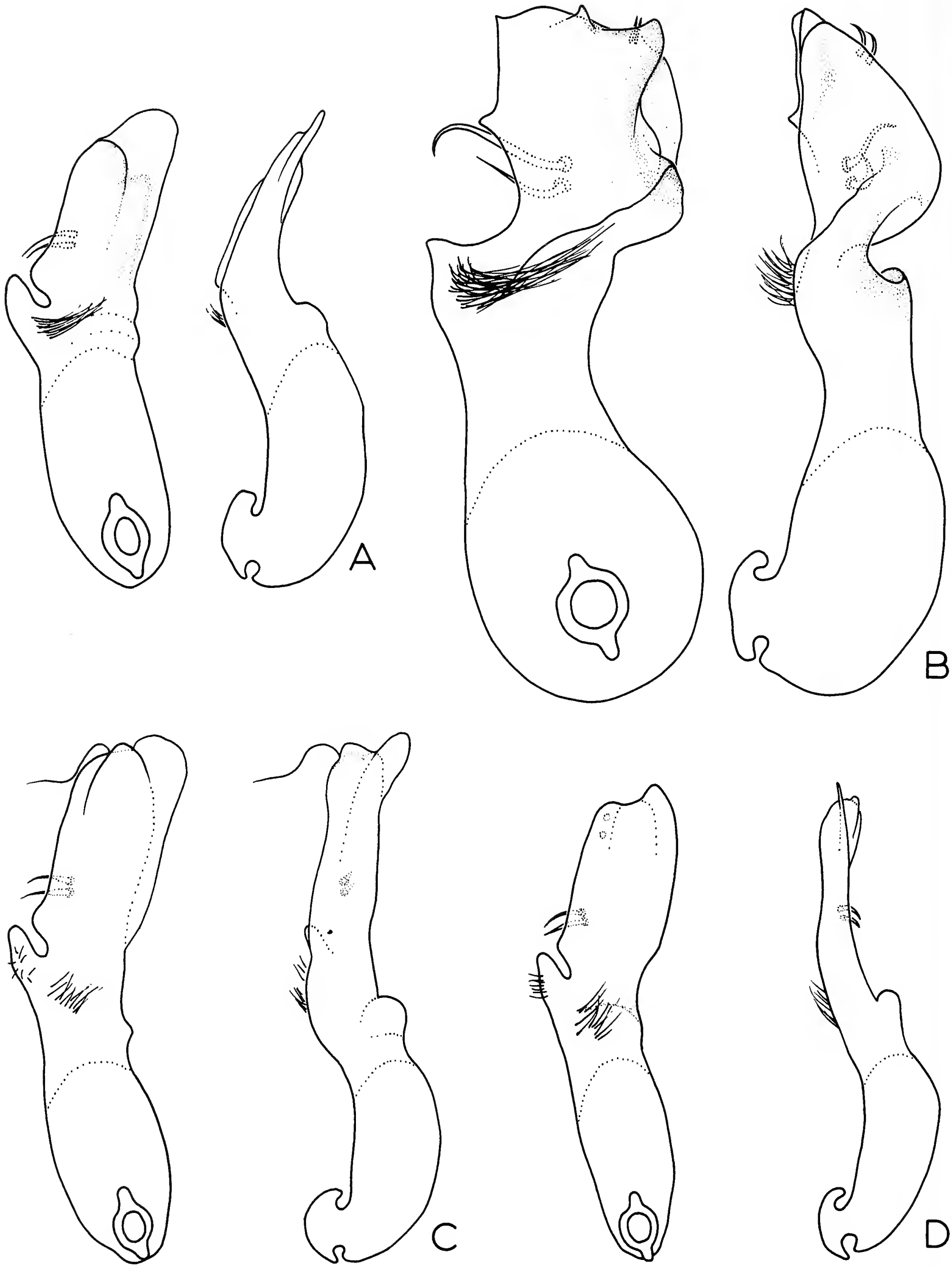
Type-specimens. – The holotype male and allotype with identical data are deposited in USNM. Paratypes from the same locality (9 males, 6 females) and 11 mi. SW Compostela, Nayarit, Mexico (1 male, 4 females) are in PDP. These specimens were collected by my wife Maureen and I, July, 1974.

Diagnosis. – Aedeagal form (Fig. 72C), small size and geographical distribution are the distinctive features of *L. mitus*.

Description. – *Form:* Broadest at posterior angles of pronotum; elytra rather narrow at rear. *Size:* Holotype 1.16 mm long, 0.58 mm wide. *Color:* Black. *Head:* Finely punctulate, microreticulation of clypeus slightly more apparent than that of frons. *Pronotum:* Finely punctulate, microreticulation extremely fine, nearly imperceptible on disc. *Elytra:* microreticulation more apparent than that of pronotum and head. Posterior marginal angles rounded, hence apices not



Figs. 76A – D, Geographical distributions of *Limnebius* species. (A) *L. alutaceus*. (B) *L. leechi* ●, *L. utahensis* ★ and *L. borealis* ▲. (C) *L. arenicolus*. (D) *L. piceus*.



Figs. 77A – D, Aedeagi of *Limnebius* holotypes. (A) *L. aridus*. (B) *L. borealis*. (C) *L. octolaevis*. (D) *L. mexicanus*.

distinctively truncate. *Abdomen:* Sternum 6 without median oval impression. *Genitalia:* Male (Fig. 72C)(11 examined).

Natural History. – The holotype and topotypes were collected at the margins of a stream in an open, arid habitat. By contrast, the five specimens from Nayarit were taken at the edge of a tropical stream surrounded by dense vegetation. Despite specific collecting efforts in many such tropical streams in Mexico and Central America, this is the only instance where I found specimens of this genus in streams of this type.

Distribution. – (Figs. 74,175). Presently known from the states of Zacatecas and Nayarit, Mexico.

Etymology. – Latin, *mitus* (mitten). This name refers to the mitten-like shape of the aedeagus.

13. *Limnebius texanus* new species
(Figs. 75E,78A,175)

Type-locality. – 2.5 mi. E. of Nickel Creek Station, Culberson County, Texas, U.S.A.

Type-specimens. – The holotype male and allotype with identical data are deposited in CFMNH. These specimens and six paratypes (2 CFMNH; 2 USNM; 2 PDP) with same data were collected by B. Malkin, September 2, 1952. Five additional paratypes, with the following data, are deposited in CFMNH: Texas, Jeff Davis Co., Limpia Creek Canyon, Davis Mts., September 5, 1952, B. Malkin.

Diagnosis. – Aedeagal form (Fig. 75E), median depression on the abdominal sternum 6 in males, and a small non-pubescent area in the middle of the metasternum in both sexes are the distinctive features of *L. texanus*.

Description. – *Form:* Broadest near anterior angles of pronotum, sides feebly arcuate. *Size:* Holotype 1.48 mm long, 0.68 mm wide. *Color:* Black. *Head:* Faintly punctulate, faintly microreticulate. *Pronotum:* Faintly punctulate, faintly microreticulate, especially on shiny disc. *Elytra:* Faintly punctulate, microreticulation more apparent than that of head; apices truncate. *Metasternum*: Non-pubescent area in midline about as wide as mesosternal process. *Abdomen:* Sternum 6 with median oval depression. *Genitalia:* Male (Fig. 75E)(4 examined).

Variation. – Females have the elytral apices feebly arcuate, and have the non-pubescent area of the metasternum smaller than males.

Distribution. – (Figs. 78A,175). Currently known only from Texas.

Etymology. – Latin adjective, *texanus*, in reference to the geographical distribution.

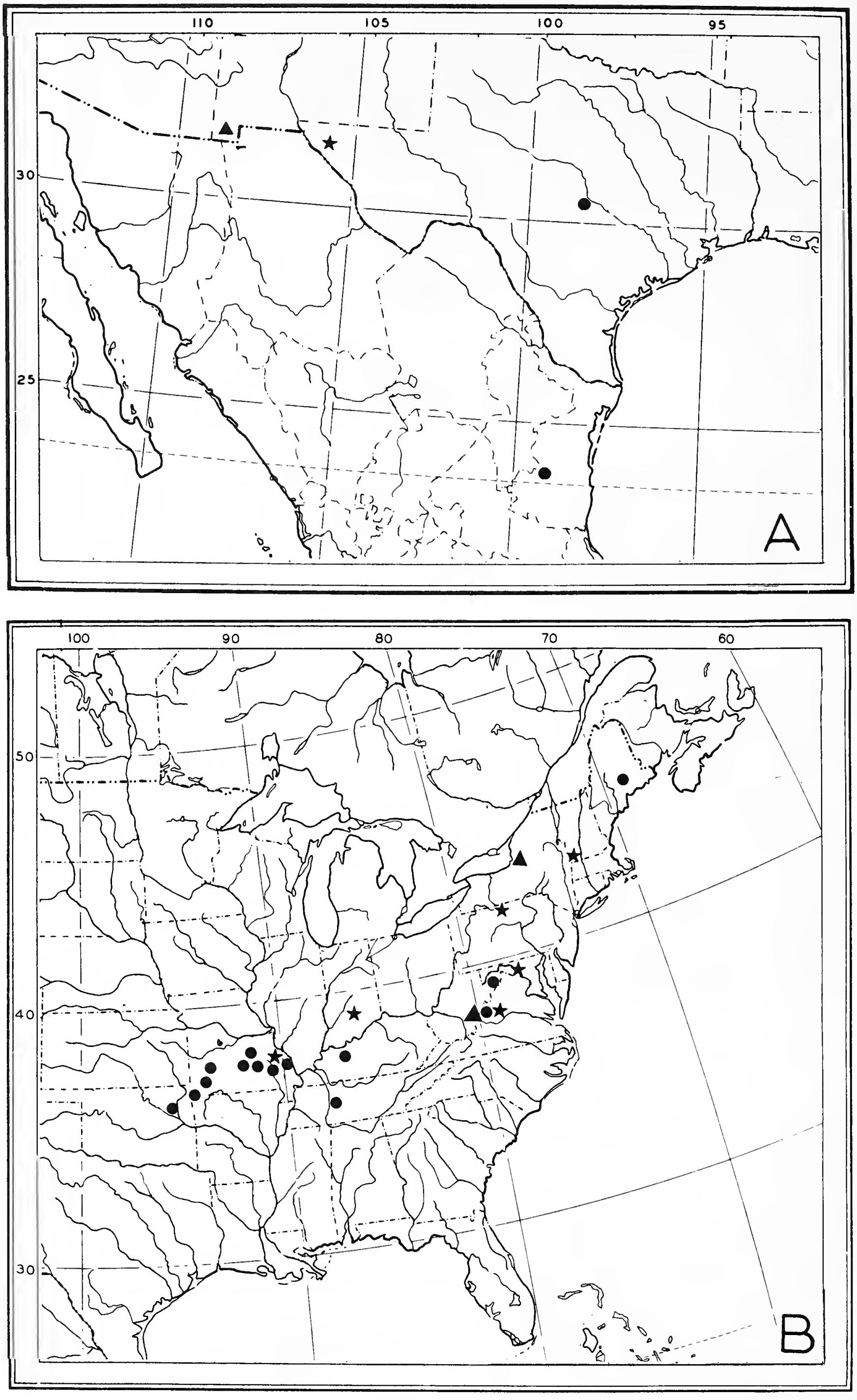
14. *Limnebius aridus* new species
(Figs. 77A,78A,175)

Type-locality. – Double Adobe Ranch, Animas Mts., 5500 feet, Hidalgo County, New Mexico, U.S.A.

Type-specimen. – The holotype male (unique) is deposited in CAS. This specimen was collected by Hugh B. Leech, August 15, 1952.

Diagnosis. – Aedeagal form (Fig. 77A) and lack of a median depression of abdominal sternum 6 in males are distinctive features.

Description. – *Form:* Broadest near posterior angles of pronotum, sides of elytra nearly straight. *Size:* Holotype 1.28 mm long, 0.64 mm wide. *Color:* Dorsum and venter black, legs and palpi brown. *Head:* Finely punctulate, finely microreticulate. *Pronotum:* Finely punctulate, finely microreticulate. *Elytra:* Finely punctulate, microreticulation more apparent than that of head; apices truncate. *Metasternum*: Small non-pubescent area in front of hind coxae. *Abdomen:* Sternum 6 with small tuft of hairs in midline at posterior border, median depression absent. *Genitalia:* Male (Fig. 77A)(1 examined).



Figs. 78A – B, Geographical distributions of *Limnebius* species. (A) *L. angustulus* ●, *L. texanus* ★ and *L. aridus* ▲ (B) *L. ozapalachicus* ●, *L. discolor* ★ and *L. richmondi* ▲.

Variation. – Females have the elytral apices arcuate laterally.

Distribution. – (Figs. 78A,175). Known only from the type-locality in New Mexico, U.S.A.

Etymology. – Latin, *aridus* (dry). I refer to the arid habitat.

15. *Limnebius mexicanus* new species
(Figs. 74,77D,175)

Type-locality. – One mile N. Ixtlan de Juarez, Oaxaca, Mexico.

Type-specimens. – The holotype male and allotype with identical data are deposited in USNM. Paratypes from the same locality are deposited in USNM (2), CAS (2), MCZ (2), CNC (2), CFMNH (2) and PDP (20). These specimens were collected by my wife Maureen and I, July 5, 1974.

Diagnosis. – Aedeagal form (Fig. 77D) and presence of a median depression on the abdominal sternum 6 of males are distinctive characteristics.

Description. – *Form:* Broadest at posterior angles of pronotum, sides of elytra rather straight. *Size:* Holotype 1.20 mm long, 0.60 mm wide. *Color:* Dorsum and venter black, legs brown. *Head:* Finely punctulate, very finely microreticulate. *Pronotum:* Finely punctulate, very finely microreticulate, especially on disc. *Elytra:* Finely punctulate, microreticulation fine but more apparent than on head; apices truncate. *Metasternum*: Pubescent throughout, hairs in midregion longer than those laterally. *Abdomen:* Sternum 6 with large median depression, posterior border of which pubescent. *Genitalia:* Male (Fig. 77D)(15 examined).

Variation. – Females have the elytral apices arcuate laterally.

Natural History. – These specimens were collected at the margin of a stream in an open, pine-oak habitat.

Distribution. – (Figs. 74,175). Known only from the type-locality.

Etymology. – Latin, adjective, *mexicanus*, in reference to the geographical distribution.

16. *Limnebius octolaevis* new species
(Figs. 74,77C,175)

Type-locality. – 25 mi. S. Huehuetenango, Totonicapan, Guatemala.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. My wife Maureen and I collected these specimens, July 1, 1974. Paratypes (31) are listed in the appendix.

Diagnosis. – Aedeagal form (Fig. 77C), shiny pronotal disc, and presence of a median depression on abdominal sternum 6 in males are distinctive features.

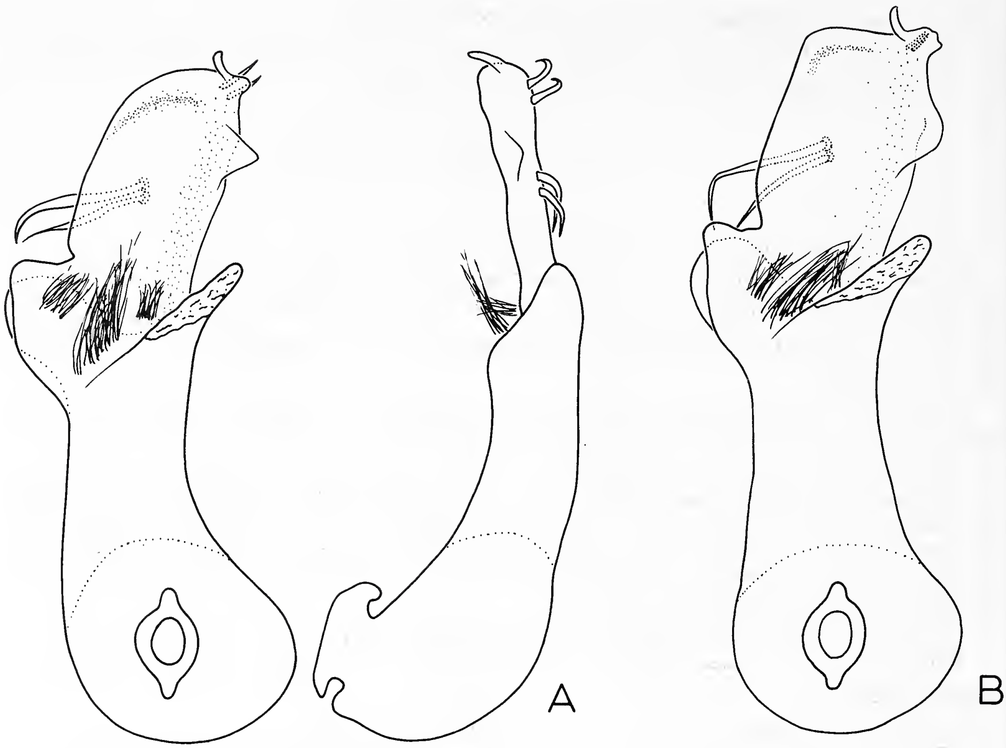
Description. – *Form:* Broadest near posterior angles of pronotum, sides of elytra nearly straight. *Size:* Holotype 1.44 mm long, 0.66 mm wide. *Color:* Dorsum and venter black, legs and palpi brown. *Head:* Finely punctulate, very finely microreticulate. *Pronotum:* Finely, but very distinctively punctulate, very finely microreticulate laterally, shiny disc not reticulate. *Elytra:* Finely punctulate, microreticulation fine, but more apparent than that of head; apices truncate. *Metasternum*: Small non-pubescent area in front of hind coxae. *Abdomen:* Sternum 6 with large median depression. *Genitalia:* Male (Fig. 77C)(20 examined).

Variation. – Females have the elytral apices arcuate laterally.

Natural History. – The topotypical specimens were collected at the margins of a small, very rapid stream.

Distribution. – (Figs. 74,175). Guatemala.

Etymology. – Latin, *octo* (eight) plus *laevis* (smooth). I refer to the smooth pronotum and its eight marginal sensilla. (six along the posterior margin, two at the anterior margin; cf. Fig. 69A, *L. octolaevis* apparently lacks the anterolateral pair seen in *L. sinuatus*).



Figs. 79A – B, Aedeagi of *Limnebius alutaceus*. (A) specimen from Curry County, Oregon. (B) specimen from British Columbia, Canada (drawn from holotype of *L. columbianus* Brown).

GENUS *GYMNOCHTHEBIUS* D'ORCHYMONT

Gymnochthebius d'Orchymont, 1943b:38 (type-species: *Ochthebius nitidus* LeConte; new status). – d'Orchymont, 1943b. – J. Balfour-Browne, 1971.

Discussion. – D'Orchymont (1943b) erected this taxon as a subgenus of *Ochthebius* based upon form of the male genitalia, which differs in basic plan from all other subunits of the genus *Ochthebius* (cf. Figs. 84A-D,100A-D). Males of *Gymnochthebius* have the "main-piece" or "median lobe" bifurcate at its apex and generally with the gonopore located in the notch between the forks. *Ochthebius* males, on the other hand, have the main-piece tapered to a point, with the gonopore situated at the apex of a preterminal, mobile process.

I have found, also, that the ejaculatory duct in *Gymnochthebius* is sclerotized, forming a rigid tube. Of the more than 175 specimens of various species I have dissected, one specimen of *G. germaini* (Fig. 85D) has this duct extended and I suspect that all males which have a tubuliform internal duct have the ability to extend this duct during copulation.

That the extended condition is so rarely seen probably relates to muscle contraction caused by alcohol in which these beetles are preserved upon capture. Proposing this function may seem

unwarranted since only a single specimen in the extended position has been studied, however, the differences in shape of the internal tube between species suggest also that the actual form of the tube is related to its function. The distinctive shapes of the tubes between species can be likened to the distinctive shapes of the terminal mobile process in species of *Ochthebius*.

In one subdivision of *Gymnochthebius (plesiotypus* Subgroup), the internal structure is not tubuliform but rather cupuliform (Figs. 81A-B,82A). I suspect that members of this group do not have the ability to extend the internal cupuliform structure. This group also differs from the other species in the genus by the abdominal sternum 5 being totally hydrofuge pubescent, and the main-piece of the aedeagus bilaterally symmetrical. In the remaining species the abdominal sternum 5 is at least partially (*germaini* Group) or totally (*nitidus* Group) without hydrofuge pubescence , and the main-piece of the aedeagus is curved, bilaterally asymmetrical (Figs. 84A-D).

In those species whose males have a bilaterally symmetrical main-piece of the aedeagus, and the internal structure is cupuliform (*G. plesiotypus, G. jensenhaarupi*, and *G. octonarius*), there are three features which are more closely similar to *Ochthebius* than to the remaining members of *Gymnochthebius*. First, the parameres are inserted on the dorsal surface of the aedeagus (in a morphological sense), as in *Ochthebius* males (cf. Figs. 81A-B,100A-D). Males of the more derived species of *Gymnochthebius*, however, have the parameres attached at the sides of the aedeagus and they are extended along the sides to the apex (Figs. 84A-D).

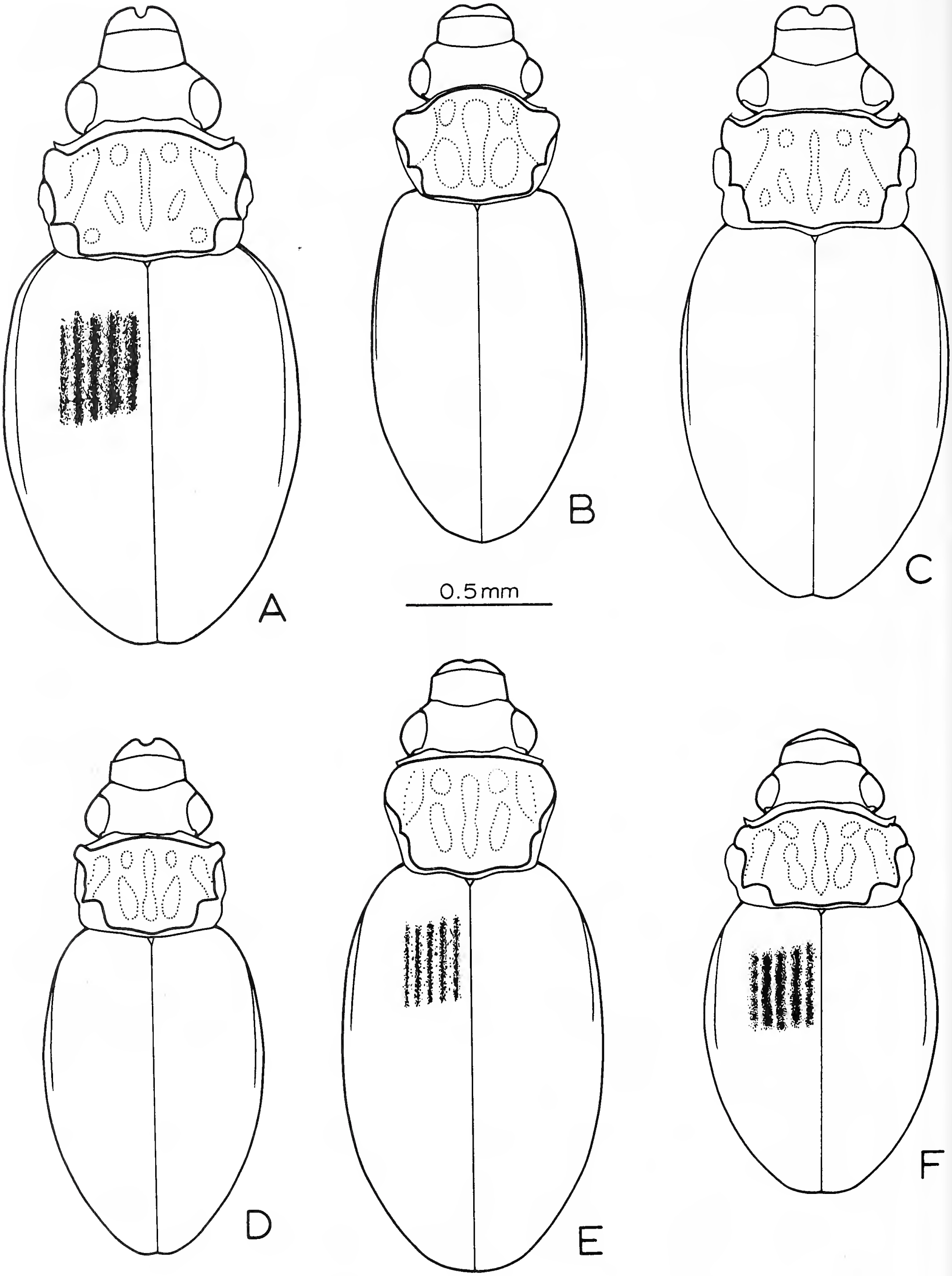
Secondly, the pronotum of adults of this less derived group of *Gymnochthebius* is shaped similarly to that of adults in *Ochthebius* (sensu stricto)(cf. Figs. 80E,82B-C,119A-H). In more derived groups of *Gymnochthebius*, the lateral depressions of the pronotum develop into the digitiform lobes so characteristic of the majority of the genus (Figs. 80A-D,F,83A-F,89A-H,96B). Lastly, species in the *plesiotypus* Group of *Gymnochthebius* have abdominal sternum 5 totally hydofuge pubescent as do the great majority of *Ochthebius*. In the two other groups of *Gymnochthebius* the hydrofuge pubescence of abdominal sternum 5 is either partially (*germaini* Group) or totally (*nitidus* Group) lost.

The aedeagus of *plesiotypus* Group males with its bifid apex and lack of a terminal process, however, clearly indicates its proper placement within *Gymnochthebius*.

Consequently, based upon morphological evidence there appears to be two phylogenetic lineages, *Gymnochthebius* and *Ochthebius*. Based upon structure of the less derived lineage within *Gymnochthebius (plesiotypus* Group), one can infer that the common ancestry is at the base of *Ochthebius* and, therefore, *Gymnochthebius* does not constitute a specialized group within *Ochthebius*. Stated differently, the probability of *Gymnochthebius* having arisen from within a species-group of *Ochthebius* is remote. Contrarily, the probability of the two lineages being worthy of equal rank is great.

If one turns now to zoogeographic evidence, the argument for equal rank of the two lineages becomes even more convincing. *Gymnochthebius* is found in the Western Hemisphere and Australia (d'Orchymont, 1943b). Within the Western Hemisphere the more primitive sub-lineage of *Gymnochthebius*, the *plesiotypus* Group, is restricted to the Andes of southern Chile and adjacent Argentina. Northward in Central and North America, the lineages are increasingly derived. One can postulate that the distribution is an austral Gondwanian pattern and, therefore, the origin of *Gymnochthebius* predates continental drift.

Those species of *Ochthebius* now known from South America (*O. lineatus* and *O. attritus*) are restricted to northern parts of the continent. Adults of both of these species are vagile, relatively widespread in North and Central America, and both are derived from a lineage



Figs. 80A – F, *Gymnochthebius* body outlines. (A) *G. reticulatissimus*. (B) *G. bartyrae*. (C) *G. reticulatus*. (D) *G. topali*. (E) *G. plesiotypus*. (F) *G. compactus*.

within North America. I suspect that other species of *Ochthebius* will be found in northern South America, but that they, also, will be derived from stocks in Central America and the Antilles, and have arrived in northern South America in relatively recent times. *Ochthebius* is absent from the remainder of South America, additional evidence that *Gymnochthebius* did not arise as a sub-lineage of *Ochthebius* (refer to the section on phylogeny and zoogeography for further comments).

Of the 25 species of *Gymnochthebius* now known from the Western Hemisphere, 16 are restricted to South America, two to Central America, six to North America, and one (*G. fossatus*) is widespread in North, Central and South America. Fourteen new species are described in the genus, and two instances of new synonomy are reported.

Pronotal features. – Most primary features of *Gymnochthebius* pronota are quite similar to those of *Ochthebius*, and the illustrated pronotum of *Ochthebius* (Fig. 98A) will suffice in general respects. One outstanding difference in adults of the two genera is differentiation of the lateral depressions into an anterior and posterior lobe in *Gymnochthebius* (e.g. *nitidus*, Fig. 96B), which occurs in certain lineages. Less derived pronota (e.g. *plesiotypus*, Fig. 80E) do not have these well differentiated lobes. Adults of some species lack posterior foveae (e.g. *maureenae*, Fig. 89A).

Diagnosis. – Form of the aedeagus, (with the main-piece bifid at the apex to form moderately defined lobes, and with the internal duct formed as a process between these lobes) is the single unifying characteristic which will invariably distinguish males of *Gymnochthebius* from those of other species of Ochthebiinae. The aedeagus of *Ochthebius* males, the genus most likely to be confused with *Gymnochthebius*, differs significantly in that the main-piece is not bifid at the apex and the internal duct is extended beyond the main-piece to form a preterminal mobile piece. In addition, the parameres are longer than the main-piece in *Gymnochthebius*, but shorter than the main-piece in *Ochthebius* (Figs. 84A-D,100A-D). Externally, the pronotal form is unique in adults of many species of *Gymnochthebius* (see generic key)(Figs. 80A-F,89A-H) and is not easily confused with that of *Ochthebius* adults. Degree of hydrofuge pubescence on the abdominal sternum 5 differs in the two genera, as discussed above.

Description. – *Form:* Generally elongate-oval, adults of some species sub-truncate, moderately convex (Figs. 80A-F,89A-H). *Size:* Length 1.20-2.24 mm, width 0.64-1.00 mm. Females generally slightly larger than males. *Color:* Most adults dark brown, few black or testaceous. *Head:* Varied from nearly impunctate and shiny to coarsely punctate and markedly microreticulate. Interocular foveae moderately developed. Interocular tuberculi (ocelli) evident. Clypeus length of most adults 0.50 width, sides convergent anteriorly. Labrum of most males upturned in anteromedian region, less so or not upturned in females. Maxillary palpus short, palpomere 3 distinctly thickened. Mentum width generally equal length, anterior margin straight or slightly arcuate to rear. Genae shining, swollen. Antennomeres nine (4+5). *Thorax:* Pronotum with well developed lateral hyaline margin, sclerotized portion varied from non-incised in anterior 0.50 (Fig. 80E), to deeply incised (Fig. 96B). Anterior margin of most adults slightly bisinuate in habitus view, anterior angles of many adults lobe-shaped. Lateral depressions of most adults impressed for length of pronotum, in few adults reduced to small foveae at anterior. Disc of most adults with well developed anterior and posterior foveae, and median groove; few adults without posterior foveae. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum hydrofuge pubescent in midregion or not. *Elytra:* Disc generally with six prominent rows of punctures between suture and humeri, each puncture with seta, few specimens with rows of punctures absent or greatly reduced; microreticulation varied from very coarse to absent. Explanate margin moderately developed. *Abdomen:* Sternum 6 and 7 without hydrofuge pubescence. Hydrofuge pubescence of sternum 5 either total, reduced to anterior 0.50, or absent. Sternum 7 of many adults with an admedian row of setae. *Legs:* Moderately long and slender. Males without distinctive protarsal pads of suction setae; metatibiae unmodified. *Genitalia:* Aedeagus with main-piece bifid, internal structure tubuliform or cupuliform, placed in lumen between forks. Spermatheca as illustrated (Figs. 9A-I).

Key to Western Hemisphere species of *Gymnochthebius*

1 (0) Abdominal sternum 5 without hydrofuge pubescence; pronotum with pronounced, digitiform anterior lobe (Figs. 89A-H,96B); North, Central and South America (*nitidus* Group) 2

1′ Abdominal sternum 5 entirely covered with hydrofuge pubescence, or with hydrofuge pubescence in anterior 0.50; pronotum with anterior lobe more rounded, less digitiform (Figs. 80A-C,E-F, 83A-F); South America 10

2 (1) Pronotal lateral depressions with posterior lobe larger than anterior lobe (Figs. 89D,E); elytral intervals subcostate; size smaller, form truncate; Mexico, Florida (*oppositus* Subgroup) 3

2′ Lateral depressions with posterior lobe much smaller than anterior lobe (Figs. 89A-C,F-H); elytral intervals flat; size larger, form more elongate 4

3 (2) Elytral intervals more elevated, each with row of decumbent setae; elytral margins with dense fringe of decumbent setae for entire length; Everglades, Florida (Figs. 89D,95C) .... *G. seminole*, new species, p. 290

3′ Elytral intervals less elevated, each with row of adpressed setae; elytral margins with fringe of decumbent setae less apparent; Baja California, Mexico; Veracruz, Mexico; and Brownsville, Texas (Figs. 89E,93A) .... *G. oppositus*, new species, p. 289

4. (2′) Elytra virtually impunctate (*laevipennis* Subgroup) 5

4′ Elytra with rows of punctures (*nitidus* Subgroup) 8

5 (4) Pronotum without posterior foveae 6

5′ Pronotum with well developed posterior foveae; Costa Rica (Figs. 89B,93I) ... . *G. perlabidus*, new species, p. 286

6 (5) Dorsal surface dull; anterior margin of pronotum arcuate; Mississippi (Figs. 89A,93J) .... *G. maureenae*, new species, p. 287

6′ Dorsal surface shiny; anterior margin of pronotum markedly bisinuate 7

7 (6′) Pronotum without anterior foveae; anterior lobe of lateral depression deflexed; Guatemala (Figs. 93B-C) .... *G. crassipes* (Sharp), p. 284

7′ Pronotum with anterior foveae; anterior lobe of lateral depression not deflexed; coastal mountain ranges, southern Oregon, California and Baja California (Figs. 89C,93E,G,H) .... *G. laevipennis* (LeConte), p. 283

8 (4′) Elytra very convex; pronotum convex; Canada and northern and eastern United States (Figs. 89H,93D,F) .... *G. nitidus* (LeConte), p. 274

8′ Elytra and pronotum less convex, somewhat depressed; North, Central and South America 9

9 (8′) Larger, approximately 1.70 mm long; more depressed; aedeagus and habitus as illustrated (Figs. 89F,91G); Arizona, Texas and Kansas .... *G. falli*, new species, p. 281

9′ Smaller, approximately 1.30 mm long; less depressed; aedeagus and habitus as illustrated (Figs. 89G,91A-F); North, Central and South America .... *G. fossatus* (LeConte), p. 277

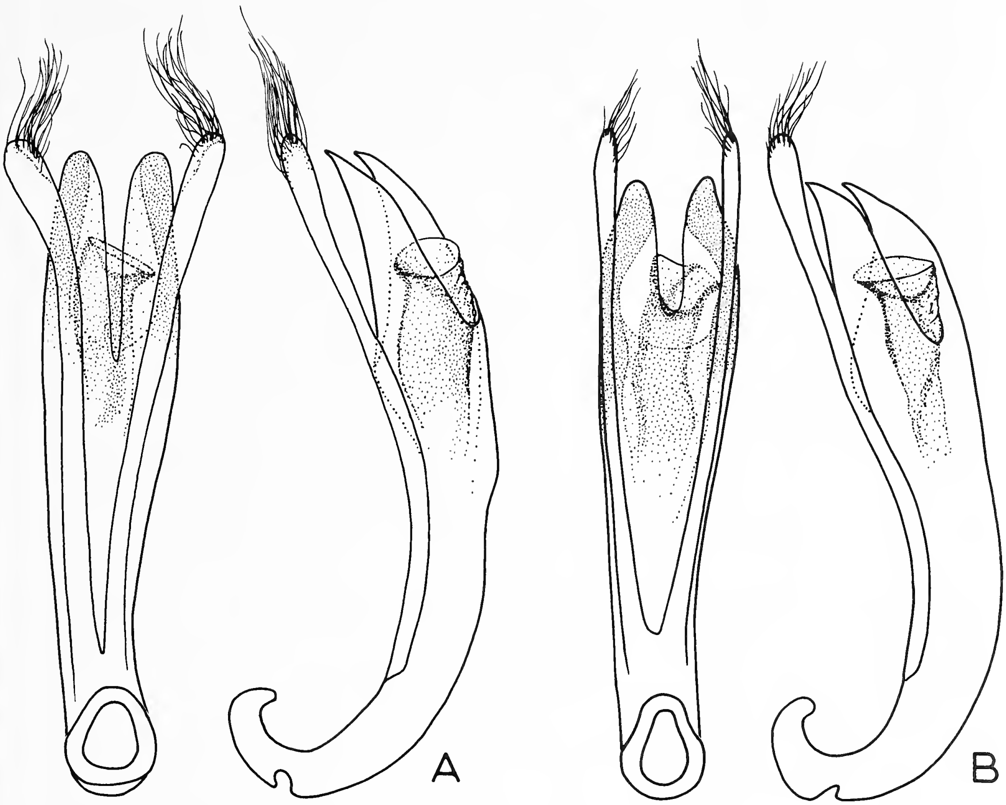
10 (1′) Abdominal sternum 5 and metasternum entirely covered with hydrofuge pubescence; size large, body broad; Chile and Argentina .... (*plesiotypus* Group) 11

10′ Abdominal sternum 5 with hydrofuge pubescence in anterior 0.50 only, posterior 0.50 glabrous; metasternum with large median glabrous area; size medium to large; South America (*germaini* Group) 13
11 (10) Pronotal foveae large, markedly microreticulate (Figs. 80E,82A); elytra deeply striate-punctate throughout .... *G. plesiotypus*, new species, p. 251
11′ Pronotal foveae small, slightly microreticulate at most (Figs. 82B-C); elytra not deeply striate-punctate 12
12 (11′) Pronotal lateral depressions extended further posterior (Figs. 81A,82B); elytral rows of punctures very fine, separated by two-three times puncture diameter, not in striae; body broader .... *G. octonarius*, new species, p. 254
12′ Pronotal lateral depressions shorter (Figs. 81B,82C); elytra with rows of larger punctures, separated by 0.5-1.0 times puncture diameter; striae moderately deep in anterior 0.50 of elytron, very shallow on remainder; body narrower .... *G. jensenhaarupi* (Knisch), p. 253
13 (10′) Pronotum quadrate, entire surface coarsely microreticulate; large, robust species (Figs. 80A,C); Argentina (*reticulatus* Subgroup) 14
13′ Pronotum less quadrate, microreticulation absent from areas between anterior and posterior foveae of side, at least, in most specimens restricted to foveae or absent; South America (*germaini* Subgroup) 15
14 (13) Elytral intervals costate, rows of punctures obscured by well developed microreticulation; pronotum uniformly microreticulate, dull (Figs. 80A,88C). . ... *G. reticulatissimus*, new species, p. 273
14′ Elytral intervals rounded, not costate, rows of punctures clearly defined, not obscured by microreticulation; pronotal disc with microreticulation slightly effaced, hence slightly more reflective than remainder of pronotum (Figs. 80C,88A) .... *G. reticulatus*, (d'Orchymont), p. 271
15 (13′) Pronotum markedly convergent to base, markedly microreticulate except between foveae of side (Figs. 80B,95A); posterior foveae very large, larger than an eye; elytra maculate and with broad, shallow depression on disc; Peru .... *G. bartyrae*, new species, p. 270
15′ Pronotum less convergent to base, microreticulation much less developed (Figs. 83A-F); posterior foveae smaller than an eye; elytra not maculate, without broad depression on disc 16
16 (15′) Pronotal anterior lobes digitiform (Figs. 80D,F,86A); pronotal reliefs very convex 17
16′ Pronotal anterior lobes rounded (Figs. 83A-F,86B-C); pronotal reliefs flat or slightly convex 19
17 (16) Elytral intervals subcostate, or narrower than diameter of punctures in rows . 18
17′ Elytral intervals flat, wider than diameter of punctures in rows (Figs. 85B,86A) .... *G. curvus*, new species, p. 262
18 (17) Elytral intervals subcostate; body form convex, truncate (Fig. 80F); Brazil ... . *G. compactus*, new species, p. 267
18′ Elytral intervals narrow, zig-zag shaped due to large, deep, serial punctures; body form not distinctively convex or truncate (Figs. 80D,90B); Chile .... *G. topali* (J. Balfour-Browne), p. 265
19 (16′) Elytra testaceous, at least in part 20

19′ Elytra brown, or dark brown 21
20 (19) Pronotum densely, coarsely punctate (Figs. 84C,86B); Peru . . . . *G. peruvianus* (J. Balfour-Browne), p. 268
20′ Pronotum very finely, sparsely punctate (Figs. 86C-E); Argentina . . . . *G. francki* (Bruch), p. 264
21 (19′) Pronotum with anterior lobes large (Figs. 83E,95B); pronotal microreticulation nearly imperceptible in foveae and lateral fossulae; Colombia . . . . *G. bisagittatus*, new species, p. 264
21′ Pronotum with anterior lobes smaller (Figs. 83A-D,F); pronotal microreticulation moderately to well developed in foveae and lateral fossulae; Chile 22
22 (21′) Elytral intervals finely microreticulate, moderately dull; larger, approximately 1.88-2.00 mm 23
22′ Elytral intervals without microreticulation, shiny; smaller, approximately 1.80 mm 24
23 (22) Body form parallel sided; ratio of elytral width to length approximately 1.0:1.5; microreticulation of elytra, pronotal foveae and fossulae less developed; aedeagus with distal branches of equal length (Figs. 83B,84A) . . . . *G. chilenus*, (J. Balfour-Browne), p. 257
23′ Body form less parallel sided; ratio of elytra width to length approximately 1.0:1.4; microreticulation of elytra, pronotal foveae and fossulae more developed; aedeagus with distal branches of unequal length (Figs. 83C-D,85A,C,D) . . . . *G. germaini*, (Zaitzev), p. 256
24 (22′) Aedeagus larger, distal branches more widely separated, internal tube sinuate (Figs. 83F,84B) . . . . *G. clandestinus*, new species, p. 258
24′ Aedeagus smaller, distal branches less widely separated, internal tube arcuate (Figs. 83A,88B) . . . . *G. tectus*, new species, p. 261

The *plesiotypus* Group

Members of this group have the metasternum and abdominal sternum 5 totally hydrofuge pubescent. Adults of its three species are large (2.00-2.50 mm), black, with accessory pronotal foveae well developed. The morphological gap separating *G. plesiotypus* from the closely similar sister-species pair, *G. jensenhaarupi* - *G. octonarius*, is considerable, involving body form (compare Figs. 80E, 82B,C) and sculpture. This large gap suggests that a number of species remain to be discovered in this group, or that extensive extinction has occurred. Absence of intensive collecting in the geographic area this group occupies leads me to suspect the former. The aedeagus in this group is unusual in that the two lobes of the median portion are symmetrical and straight, and the internal structure is cup-shaped, with a large terminal opening (Figs. 81A,B,82A). I regard these genitalic characters as pleisotypic. Among the other species in the subgenus, only males of *G. reticulatus* and *G. reticulatissimus* have straight, nearly symmetrical aedeagi (Figs. 88A,C). However, they have the internal structure tube-shaped as do males of the remainder of the subgenus (see the remarks section of *G. reticulatus* for comments regarding the apparent lack of an internal tube). Males of all other



Figs. 81A – B, Aedeagi of *Gymnochthebius* species. (A) *G. octonarius*, holotype. (B) *G. jensenhaarupi*, lectotype.

species of *Gymnochthebius* have the aedeagus sinuate in dorsal view, and asymmetrical (such as in Figs. 84A-D).

Species of the *plesiotypus* Group live on the eastern slope of the Andes in Argentina and on the western in Chile. The only habitat information available indicates that specimens of *G. plesiotypus* were taken from pools adjacent to a river. This apparently lentic habitat preference requires verification, as lotic species in the genus are frequently displaced downstream and deposited in streamside pools.

1. *Gymnochthebius plesiotypus* new species
(Figs. 80E,82A,176A)

Type-locality. – Concepcion region, Chile.

Type-specimens. – The holotype male is deposited in USNM; collector unknown. The allotype, collected by G. Topal at El Bolson, Rio Negro Province, Argentina, is deposited in USNM. Paratypes (6) have the same data as allotype and are deposited in HNHM, BMNH and PDP.

Diagnosis. – Deeply striate-punctate elytra, large pronotal foveae and body form (Figs. 80E,82B,C) serve to readily distinguish *G. plesiotypus* adults from those of *G. jensenhaarupi* and *G. octonarius*, the only other species in the genus *Gymnochthebius* with metasternum and abdominal sternum 5 totally hydrofuge pubescent.

Description. – *Form:* Elongate-oval, moderately depressed (Fig. 80E). *Size:* Holotype 2.02 mm long, 0.92 mm wide. *Color:* Dorsum black; venter, legs and palpi dark brown. *Head:* Length 0.38 mm; width 0.50 mm. Frons markedly microreticulate, finely sparsely punctate, very sparsely pubescent; interocular foveae deep and large, width of each 0.50 distance between them; interocular tuberculi large; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, markedly microreticulate. Labroclypeal suture straight. Labrum length 0.33 width; markedly microreticulate, sparsely pubescent; median emargination well developed, edge slightly upturned. Maxillary palpus with palpomere 2 moderately wide; palpomere 4 0.50 length of palpomere 3. Mentum width equal length, shining, finely sparsely punctate, markedly microreticulate; anterior margin very slightly arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (near anterior 0.33) 0.62 mm. Anterior hyaline border narrow in front of disc, slightly wider in front of lateral fossulae. Lateral hyaline border very narrow, origin near midlength of lateral depressions. Anterior margin of pronotum slightly arcuate to rear. Lateral depressions with evenly rounded margins, very small tooth at posterior extreme; microreticulate. Pronotum moderately constricted behind lateral depressions. Lateral fossulae deep, arcuate, markedly microreticulate, inner margin abrupt, outer margin slightly defined, posterior extreme extended to lateral hyaline border. Pronotal disc moderately shiny, slightly convex, extremely finely, extremely sparsely punctate, faintly microreticulate, sparsely pubescent. Median groove markedly microreticulate, deep, moderately wide, slightly constricted in midregion. Anterior foveae oval, deep, markedly microreticulate, width equal distance between fovea and median groove. Posterior foveae deep, length twice width, length three times that of anterior fovea, markedly microreticulate. Posterolateral angles with very shallow impressions. Prosternum with median carina ending at coxal cavities; coxae contiguous. Metasternum entirely covered with hydrofuge pubescence, without median glabrous area. *Elytra:* Length 1.36 mm; maximum width (near midlength) 0.92 mm. Disc flat, moderately shiny, with six rows of punctures between suture and humeri, each puncture with seta; rows of punctures microreticulate, as are intervals, latter less so. Declivity origin near posterior 0.33. Intervals rounded, slightly elevated, width equal puncture width. Interstices between punctures obscured by microreticulation. Explanate margin moderately developed. *Abdomen:* Basal five sterna entirely covered with hydrofuge pubescence. Sternum 6 shiny, sparsely pubescent. Sternum 7 shiny; setae of submedian setal groups moderately short. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.8/1. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Fig. 82A)(3 examined).

Variation. – The specimens from El Bolson, Argentina are much larger than the holotype, males and females approximately 2.50 mm long. Additionally, the Argentinian specimens have the dorsal microreticulation more evident and are, therefore, somewhat duller than the holotype. However, the aedeagi of the two Argentinian males I have studied are virtually identical in all respects, including shape of the internal structure, to that of the holotype. Consequently, I believe these specimens represent a single species. Males are easily distinguished from females by the two rows of submedian setae on abdominal sternum 7 and the more narrowly explanate elytral margin.

Natural History. – J. Balfour-Browne (1971) reports that the Argentinian specimens are "from water in pool in inundated area of Rio Quemquemtrei" and "from under stones and from mud near stagnant water of Rio Quemquemtrei".

Distribution. – (Fig. 176A). Known from Concepcion Province, Chile and Rio Negro Province, Argentina.

Etymology. – Latin, *plesio* (near) plus *typus* (model). Adults of this species have a combination of three morphological features one might suspect to be present on a "primitive model" of the common ancestor of *Gymnochthebius* and *Ochthebius*: 1) pronotal form, which is virtually identical to that seen in the majority of species of *Ochthebius (sensu stricto)* Leach; 2)

aedeagal form, which is bilaterally symmetrical, except for the internal structure, and is bilobed; and 3) abdominal sternum 5 covered with hydrofuge pubescence.

Remarks. – J. Balfour-Browne (1971) discussed and illustrated this species under the name *G. jensenhaarupi* Knisch. He mentioned the discrepancy between features of the elytra of the specimens and Knisch's description, then stated that "so close is the agreement of the gentalia with d'Orchymont's figure, that I hesitate to treat these specimens as representing a new species without a direct comparison with Knisch's type". The genitalia of the two species (Figs. 82A,C), however, are quite distinct. This serves to point out the need to illustrate the aedeagi in two views and with much more detail than has been provided in previous works.

2. *Gymnochthebius jensenhaarupi* (Knisch)
(Figs. 81B,82C,176A)

Ochthebius jensenhaarupi Knisch, 1924:114 (lectotype male in ISNB, here designated; type-locality: Station Santa Rosa, Mendoza, Mendoza Province, Argentina). d'Orchymont, 1943:38. – J. Balfour-Browne, 1971:180.

Diagnosis. – Totally pubescent abdominal sternum 5 and metasternum, together with large size, shiny black dorsum and unusual pronotal shape serve as diagnostic characteristics to readily distinguish *G. jensenhaarupi* adults from those of all *Gymnochthebius* species except *G. octonarius*, its putative sister-species. Adults are very similar to those of *G. octonarius* in most features, but differ slightly in pronotal, elytral and aedeagal form. The pronotal lateral depressions of *G. octonarius* adults extend further posterior, causing the lateral hyaline borders to originate at approximately the midlength of the pronotum, whereas the lateral depressions of *G. jensenhaarupi* adults are shorter, the lateral hyaline border having its anterior extreme near the anterior 0.33 of the pronotum (Figs. 82B,C). The posterior foveae are more apparent in *G. jensenhaarupi*, in the few specimens studied. The elytra of *G. jensenhaarupi* adults are striate-punctate, the striae very lightly impressed on the disc, more deeply impressed in the anterior 0.20; the elytral punctures are larger, the spaces between punctures of a row 0.5-1.0 times puncture diameter and the rows separated by one-two times puncture diameter. In contrast, the elytra of *G. octonarius* adults have very small, lightly impressed, widely separated serial punctures which are not in striae; both the distance between punctures of a row and that between punctures of adjacent rows are two-three times puncture diameter. Another external difference between the types of the two species is shape of the labroclypeal suture, which is straight in *G. octonarius* and distinctly arcuate to rear in *G. jensenhaarupi*; further specimens are needed to verify the constancy of this apparent difference. The aedeagus of *G. jensenhaarupi*, when compared to that of *G. octonarius* (Figs. 81A,B), gives the visual impression that most of the structure has been extended further toward the apex; therefore the aedeagus, in both dorsal and lateral views, tapers more abruptly to the apex in *G. jensenhaarupi*. Additionally, the internal aedeagal tube is shaped differently in these putative sister-species.

Description. – *Form:* Elongate-oval, moderately convex (Fig. 82C). *Size:* Lectotype 2.20 mm long and 0.96 mm wide. *Color:* Dorsum and venter black; legs and palpi brown. *Head:* Length 0.38 mm; width 0.54 mm. Frons finely sparsely punctate, very sparsely pubescent; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large, but not well delimited; basomedial fovea very small. Frontoclypeal suture arcuate. Clypeus length 0.50 width, finely sparsely punctate, sparsely pubescent. Labroclypeal suture distinctly arcuate to rear, anterior angles acute. Labrum length 0.33 width; finely sparsely punctate, sparsely pubescent; median emargination slightly developed, edge very slightly upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 slightly greater than 0.50 length of palpomere 3. Mentum width equal length, shining, finely densely punctate; anterior margin straight. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.50 mm; maximum width (near anterior 0.33) 0.66 mm. Anterior hyaline border narrow in

front of disc, slightly wider in front of lateral fossulae. Lateral hyaline border origin near midlength of lateral depressions, extended narrowly to posterior angles, very narrow around posterior margin. Anterior margin of pronotum slightly arcuate in midregion. Lateral depressions broad, moderately long, with prominent tooth at posterior extreme; surface between margin and fossula nearly impunctate. Pronotum slightly constricted behind lateral depressions. Lateral fossulae deep, microreticulate, not extended to tooth at lateral hyaline border. Pronotal disc shiny, very slightly convex, extremely finely, extremely sparsely punctate, sparsely pubescent. Median groove narrow, shallow, faintly microreticulate. Anterior foveae small, deep, width 0.50 distance between fovea and median groove. Posterior foveae shallow, linear impressions with very faint microreticulation; width 0.33 distance between fovea and median groove. Posterolateral angles with deep, oval impressions, latter larger than anterior foveae. Four small, distinct, oval depressions on disc, one posterior to each posterior fovea and one anterior to each anterior fovea (Fig. 82C). Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum entirely covered with hydrofuge pubescence, without median glabrous area. *Elytra:* Length 1.44 mm; maximum width (near midlength) 0.96 mm. Disc flat, shiny, with six rows of round punctures between suture and humeri, each puncture with seta. Declivity origin near posterior 0.33. Intervals flat, width one-two times puncture width. Interstices between punctures 0.5-1.0 times puncture diameter. Rows of punctures in striae very lightly impressed on disc, more deeply impressed in anterior 0.50 of elytra. *Abdomen:* Basal five sterna entirely covered with hydrofuge pubescence. Sternum 6 shiny, sparsely pubescent. Sternum 7 shiny; setae of submedian setal groups long. *Legs:* Moderately long and slender; ratio of hind leg length of abdominal length 2.0:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Fig. 81B)(1 examined).

Distribution. – (Fig. 176A). Known only from the type-locality in Mendoza Province of western Argentina.

Remarks. – The discussion and figures presented by J. Balfour-Browne (1971), based upon specimens which he presumed to be *Ochthebius jensenhaarupi*, are actually based upon specimens of *G. plesiotypus*, described herein. Other than the lectotype, I have seen but a single female of *G. jensenhaarupi.*

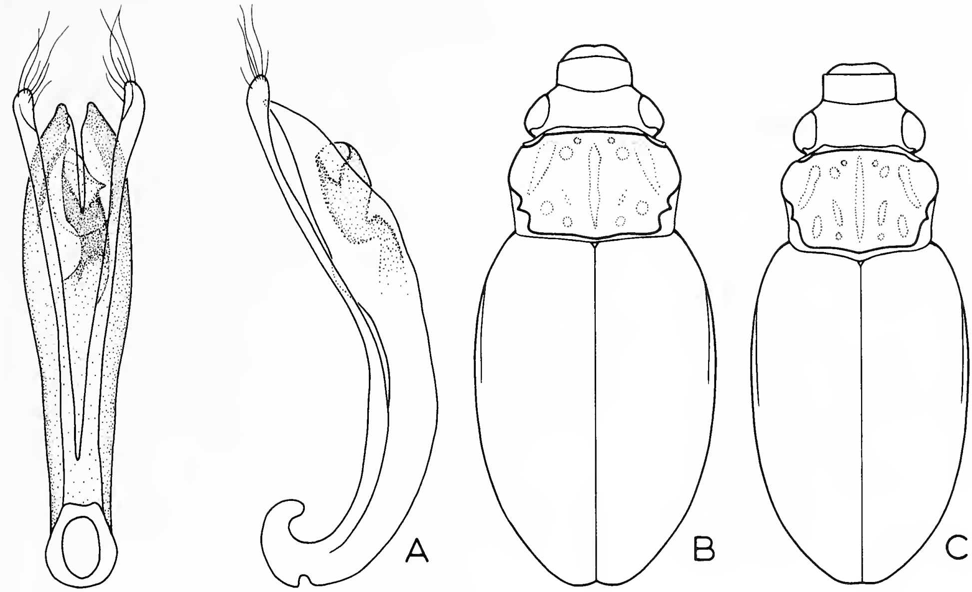
3. *Gymnochthebius octonarius* new species
(Figs. 81A,82B,176A)

Type-locality. – 15 km. W. Tucuman, Tucuman Province, Argentina.

Type-specimens. – The holotype male, allotype and seven paratypes, all with identical locality data, are deposited in USNM. These specimens were collected by Paul and Phyllis Spangler, May 22, 1969.

Diagnosis. – Large size, shiny black dorsum with unusual pronotal shape (Fig. 82B) together with totally hydrofuge pubescent metasternum and abdominal sternum 5 readily distinguish *G. octonarius* adults from those of all *Gymnochthebius* species except *G. jensenhaarupi*, its putative sister-species. Refer to the diagnosis of *G. jensenhaarupi* for a comparison of these two species.

Description. – *Form:* Elongate-oval, moderately convex (Fig. 82B). *Size:* Holotype 2.24 mm long, 1.00 mm wide. *Color:* Dorsum and venter black; legs and palpi brown. *Head:* Length 0.40 mm; width 0.56 mm. Frons finely moderately sparsely punctate, very sparsely pubescent; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial fovea very small. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, finely sparsely punctate, sparsely pubescent. Labroclypeal suture straight. Labrum length 0.33 width; finely sparsely punctate, sparsely pubescent; median emargination slightly developed, edge upturned. Maxillary palpomere 3 moderately wide; palpomere 4 0.50 length of palpomere 3. Mentum width equal length, shining, finely densely punctate; anterior margin straight. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.50 mm; maximum width (near anterior 0.33) 0.72 mm. Anterior hyaline border narrow in front of disc, slightly wider in front of lateral fossulae. Lateral hyaline border origin near posterior 0.33 of lateral depressions, extended narrowly to posterior angles, very narrow around posterior margin. Anterior margin of pronotum straight in midregion, broadly excavate in front of lateral depressions. Lateral depressions broad, long, with prominent tooth at posterior extreme; surface nearly impunctate. Pronotum weakly constricted behind lateral depressions. Lateral fossulae deep, microreticulate, inner and outer margins equally, moderately abrupt, posterior extreme extended nearly to tooth at lateral hyaline border. Pronotal disc shiny, very slightly convex, extremely finely, extremely sparsely punctate, sparsely pubescent. Median groove narrow, shallow, microreticulate. Anterior foveae circular, deep, small, width 0.50 distance between foveae and median groove. Posterior foveae very small and indistinctly defined, consisting of series of three or four punctures, lightly impressed. Posterolateral angles with distinct, shallow, circular fovea,



Figs. 82A – C. (A) *Gymnochthebius plesiotypus*, aedeagus of holotype. (B) *G. octonarius* body outline. (C) *G. jensenhaarupi*, body outline.

diameter 0.33 distance between fovea and median groove, diameter equal that of anterior foveae, extremely faintly microreticulate. Four small, distinct, oval depressions on disc, one posterior to each posterior fovea and one anterior to each anterior fovea (Fig. 82B). Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum covered with hydrofuge pubescence, without median glabrous area. *Elytra:* Length 1.48 mm; maximum width (near midlength) 1.00 mm. Disc flat, shiny, with six rows of small round punctures between suture and humeri, each puncture with seta. Declivity origin near posterior 0.33. Intervals flat, width two-three times puncture diameter. Interstices between punctures two-three times puncture diameter. Explanate margin moderately developed. *Abdomen:* Basal five sterna covered with hydrofuge pubescence. Sternum 6 shiny, sparsely pubescent. Sternum 7 shiny; setae of submedian setal groups long. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 2.0:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Fig. 81A)(2 examined).

Variation. – Some paratypes lack posterior foveae.

Distribution. – (Fig. 176A). Known only from the type-locality in Tucuman Province, northwestern Argentina.

Etymology. – Latin, *octonarius* (consisting of eight). I refer to the eight prominent foveae of the pronotum, consisting of four "accessory" foveae (pronotal sensilla) plus the two anterior foveae and the single prominent fovea at each posterolateral angle. The very faint posterior foveae are not included in this group of eight.

The *germaini* Group

The single unifying character which indicates that this aggregate of species is a natural group is distribution of hydrofuge pubescence on abdominal sternum 5: present on the anterior one-half, and absent from the posterior one-half. Additionally, adults of all species have the median region of the metasternum glabrous, and most have the anterior pronotal lobes moderately digitiform, midway in form between the more rounded lobes of the *plesiotypus* Group and the more digitiform lobes seen in the *nitidus* Group. Adults of one species in this group, *O. compactus* from Brazil, is rather similar in habitus appearance to those of certain species in the *nitidus* Group, which suggests that perhaps species uniting the two groups may be awaiting discovery in the neotropics. Adults of several species, especially some from Chile, are very similar in habitus and require examination of the aedeagus for positive identification. The group as a whole, however, is structurally quite diverse, with most differences relating to shape of the pronotum, but with other very distinctive character states expressed in certain species. These varying character states include degree of development of microreticulation and pronotal foveae, degree of flatness of lateral depressions, degree of elevation of elytral intervals, and body size.

Species in this group live in Argentina, Brazil, Colombia, Chile and Peru. Further collecting will probably reveal that the group range also includes montane regions of South America.

The *germaini* Subgroup

Members of the *germaini* Subgroup have the dorsal microreticulation generally very reduced (*G. bartyrae* is a notable exception) and are usually medium sized (1.50 - 1.80 mm). The aedeagus is sinuate and asymmetrical in dorsal view, and has the parameres lying along the sides of the median portion.

Currently there are 11 species representing this subgroup.

4. *Gymnochthebius germaini* (Zaitzev)
(Figs. 9E,83C,D,85A,C,D,87A,177)

Ochthebius aeneus Germain, 1855:390 (*nec* Stephens 1835).
Ochthebius sulcicollis Germain, 1901:530 (*nec* Sturm 1836).
Ochthebius germaini Zaitzev, 1908:530 (holotype female deposited in MHNC; type-locality: Quillota, Valparaiso Province, Chile). d'Orchymont, 1929:100. – d'Orchymont, 1943:37. – J. Balfour-Browne, 1971:177.

Mr. J. Balfour-Browne has discussed this species and established the type-specimen; I accept his conclusion.

Diagnosis. – *G. germaini* is one of four Chilean species whose adults are very difficult to distinguish from one another using external features. The other three species in this troublesome aggregate are *G. chilenus*, *G. clandestinus*, and *G. tectus*. Using external features,

one can perhaps recognize *G. germaini* and *G. chilenus* after a representative number of males have been dissected and the aedeagi studied to assure proper species assignment. However, it is probably impossible at present to adequately communicate the subtle external differences between these four species. All determinations made regarding these four species should be based upon study of the male genitalia.

Description. – *Form:* Ovate, moderately convex (Figs. 83C,D). *Size:* Holotype 1.82 mm long, 0.84 mm wide. *Color:* Dorsum and venter dark brown; legs, palpi and elytral epipleura brown. *Head:* Length 0.34 mm; width 0.48 mm. Frons finely sparsely punctate, very sparsely pubescent, microreticulate laterally; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, finely sparsely punctate, sparsely pubescent. Labroclypeal suture straight. Labrum length 0.33 width; finely sparsely punctate, sparsely pubescent; median emargination moderately developed, with upturned edge, labrum evenly rounded in habitus view. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of palpomere 3. Mentum width equal length, shining, finely sparsely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.46 mm; maximum width (near anterior 0.33) 0.64 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae. Lateral hyaline border origin near midlength of anterior lobe of lateral depressions, moderately arcuate to posterior lobe, more strongly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum slightly arcuate. Lateral depressions finely sparsely punctate, sparsely pubescent; anterior lobe width equal length, much larger than posterior lobe, anterior extreme arcuate; posterior lobe angulate, forming nearly a 90 degree angle. Pronotum moderately constricted behind lateral depressions. Lateral fossulae deep, markedly microreticulate, inner margin abrupt, outer margin well demarcated, inner and outer margins nearly parallel. Pronotal disc shiny, slightly convex, moderately sparsely, moderately finely punctate, sparsely pubescent. Median groove narrow, moderately shallow, faintly microreticulate. Anterior foveae oval, deep, width 0.50 distance between fovea and median groove. Posterior foveae deep, length two-three times width, length twice that of anterior fovea, microreticulate. Posterolateral angles with very shallow impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.20 mm; maximum width (near midlength) 0.84 mm. Disc flat, moderately shiny, with 6 rows of round punctures between suture and humeri, some punctures subconfluent, each puncture with seta. Declivity origin near posterior 0.33. Intervals flat, width equal puncture width; interstices between punctures 0.25 puncture length, or less. Explanate margin moderately developed. *Abdomen:* Basal four sterna entirely covered with hydrofuge pubescence. Sternum 5 with posterior arc of glabrous area; anterior limits of latter near midlength of segment in midline, near posterior angles laterally. Segment 6 shiny, sparsely pubescent. Apical segment shiny; setae of submedian setal groups moderately long. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.6/1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Figs. 85A,C,D)(22 examined); female (Fig. 9E).

Variation. – I have seen one male from Rio Nirivilo, Maule Province, Chile which differs greatly in external characteristics from the other specimens of *G. germaini*. These external differences include: 1) shape of the pronotum (Fig. 83D)(anterior lobes much larger than posterior lobes in *G. germaini*, nearly equal in size in this unusual specimen); 2) development of microreticulation (less prominent in this specimen, especially in the lateral fossulae); 3) elytral form (*G. germaini* has closely spaced, deep rows of punctures, whereas the specimen in question has widely spaced, shallow punctures); and 4) size (this specimen is much smaller, 1.56 mm long vs 1.80 mm). However, I can detect no significant differences in the aedeagus of this specimen (Figs. 85A,C). Therefore, despite these obvious external differences, I feel it is unwise to describe this specimen as representing a new species without having large numbers of specimens from throughout the range of *G. germaini*. Future collecting will undoubtedly provide the specimens to resolve this problem.

Distribution. – (Figs. 87A,177). Chile. I have examined 60 specimens (see appendix for locality data).

5. *Gymnochthebius chilenus* (J. Balfour-Browne)
(Figs. 9G,83B,84A,177)

Ochthebius chilenus J. Balfour-Browne, 1971:179 (holotype male deposited in MHNC; type-locality: Mininco, Malleco

Province, Chile).

Diagnosis. – Specimens of *G. chilenus* can be reliably separated from those of *G. germaini*, *G. clandestinus*, and *G. tectus* only by referral to the aedeagus. Refer to the diagnosis of *G. germaini* for further comments.

Description. – *Form:* Ovate, moderately convex (Fig. 83B). *Size:* Holotype 1.93 mm long and 0.84 mm wide. *Color:* Dorsum black; venter dark brown; legs and palpi brown. *Head:* Length 0.38 mm; width 0.52 mm. Frons finely moderately densely punctate, very sparsely pubescent, microreticulate laterally; interocular foveae moderately deep and large, width of each 0.5 distance between them; interocular tuberculi large; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.5 width, finely sparsely punctate, sparsely pubescent, markedly microreticulate laterally. Labroclypeal suture straight. Labrum length 0.33 width; finely sparsely punctate, sparsely pubescent; median emargination slightly developed, edge upturned, evenly rounded in habitus view. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.5 length of 3. Mentum width equal length, shining, finely densely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.48 mm; maximum width (near anterior 0.33) 0.70 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral depressions, then tapered to anterior angles. Lateral hyaline border beginning near anterior 0.33 of lateral depression, sides straight, slightly convergent; border moderately wide in region of lateral depressions, wider at excavations, very narrow around posterior margin. Anterior margin of pronotum slightly arcuate in midregion. Lateral depressions finely, moderately sparsely punctate; anterior lobe slightly produced, wider than long, larger than posterior lobe, anterior extreme arcuate; posterior lobe angulate, angle nearly right. Pronotum moderately constricted behind lateral depressions. Lateral fossulae deep, microreticulate, inner margin abrupt, posterior extreme extended to lateral hyaline border. Pronotal disc shiny, slightly convex, moderately finely, moderately densely pubescent. Median groove shallow, narrow, microreticulate. Anterior foveae moderately elongate ovals, width equal 0.50 distance separating fovea and median groove. Posterior foveae deep, narrow, width 0.25 length, length twice that of anterior fovea, faintly microreticulate. Posterolateral angles with shallow impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.32 mm; maximum width (near midlength) 0.86 mm. Disc flat, shiny, with six rows of round punctures between suture and humeri, each puncture with a seta. Declivity beginning near posterior 0.33. Intervals flat, width slightly greater than puncture width; alternate intervals, beginning with second from suture, each with very sparse row of setae. Interstices between punctures 0.25 puncture length. Explanate margin moderately developed. *Abdomen:* Basal four sterna entirely covered with hydrofuge pubescence. Sternum 5 with posterior arc of glabrous area with anterior limits near midlength of segment in midline, near posterior angles laterally. Segment 6 shiny, sparsely pubescent. Apical segment shiny; setae of submedian setal group short. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.6/1.0. Protarsomeres 1 and 2 with weakly developed suction setae. *Genitalia:* Male (Fig. 84A)(9 examined); female (Fig. 9G).

Distribution. – (Figs. 87A,177). Chile. Thirteen specimens were studied (see appendix).

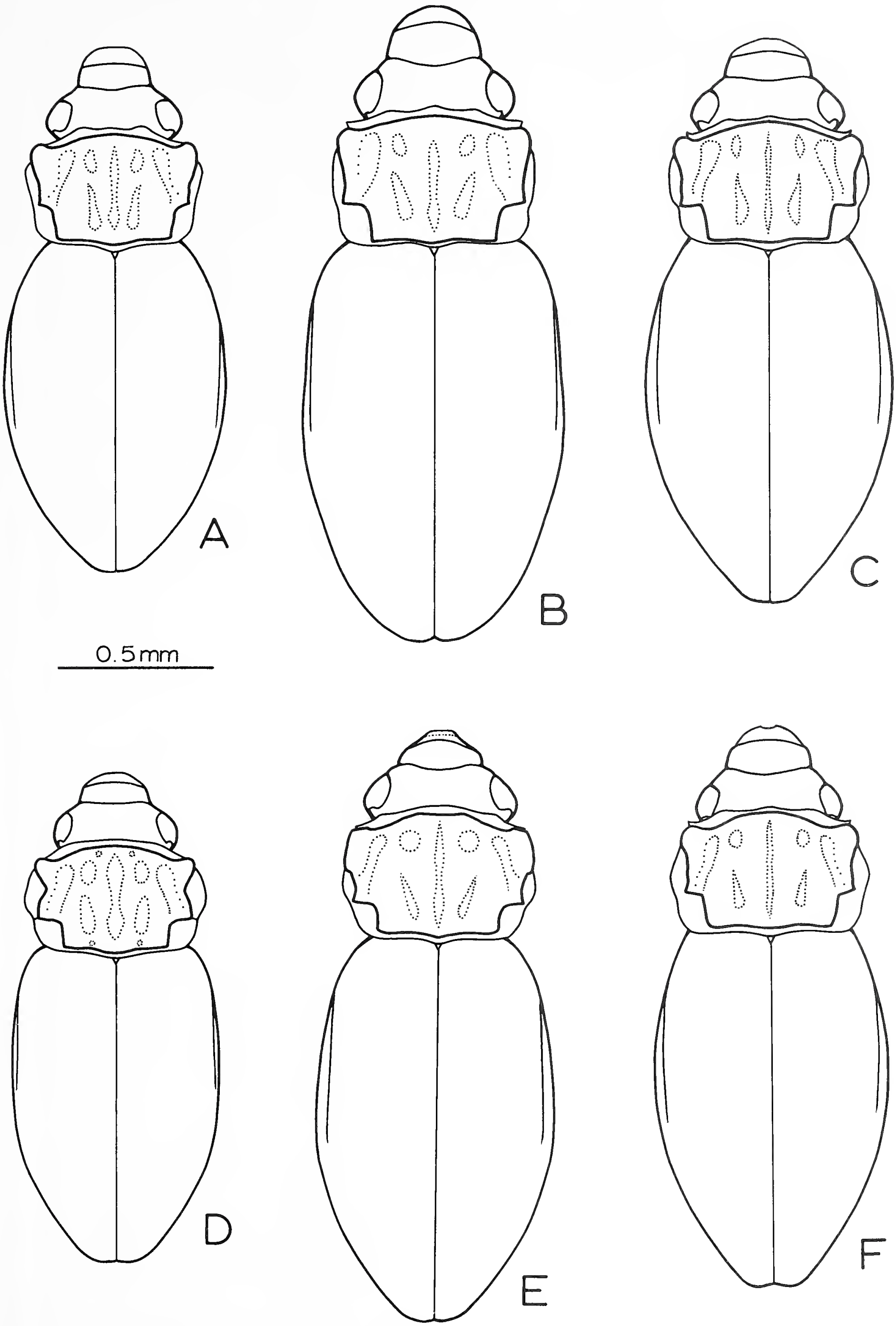
6. *Gymnochthebius clandestinus* new species
(Figs. 9A,83F,84B,87B,149B,152B,177)

Type-locality. – Rio Nirivilo, Maule Province, Chile.

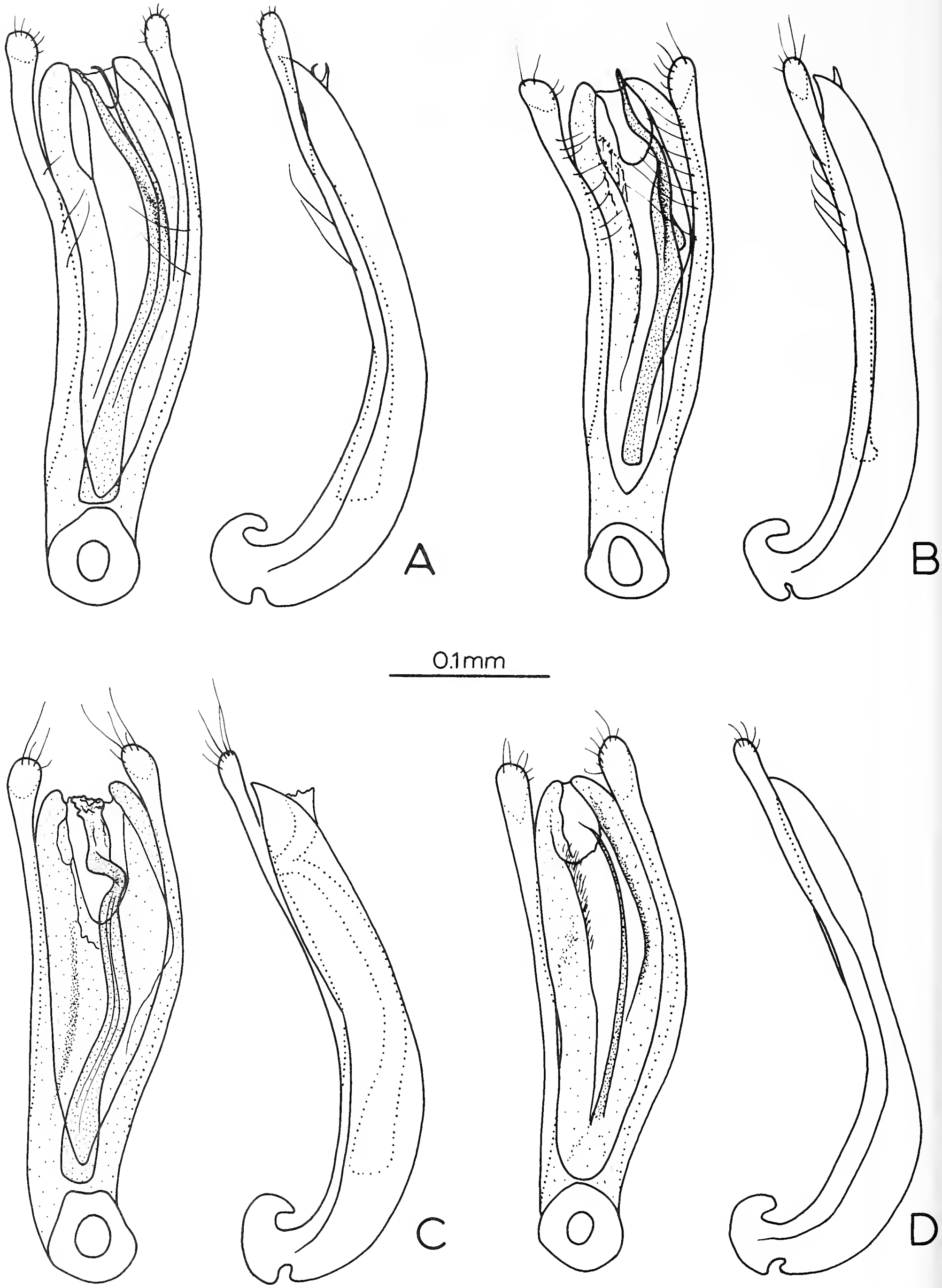
Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. These specimens were collected by H.P. Brown, November 2, 1971. Data about paratypes (190) are presented in the appendix.

Diagnosis. – Genitalic characteristics must be used to reliably separate males of *G. clandestinus* from those of three other Chilean species, *G. germaini*, *G. chilenus* and *G. tectus*. Refer to the diagnosis of *G. germaini* for additional comments.

Description. – *Form:* Ovate, moderately convex (Fig. 83F). *Size:* Holotype 1.80 mm long, 0.80 mm wide. *Color:* Dorsum and venter dark brown; legs and palpi brown. *Head:* Length 0.34 mm; width 0.46 mm. Frons shiny, finely sparsely punctate, very sparsely pubescent; interocular foveae deep, width of each 0.5 distance between them; interocular tuberculi large; basomedial fovea transverse. Frontoclypeal suture angulate. Clypeus length 0.5 width, finely sparsely punctate, sparsely pubescent. Labroclypeal suture straight. Labrum length 0.33 width; finely sparsely punctate, moderately sparsely pubescent; median emargination moderately developed, edge upturned. Maxillary palpus palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, finely sparsely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near anterior 0.33) 0.62 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of area between anterior foveae and lateral fossulae. Lateral hyaline border



Figs. 83A – F, *Gymnochthebius* body outlines. (A) *G. tectus*. (B) *G. chilenus*. (C) *G. germaini*. (D) *G. germaini* variant. (E) *G. bisagittatus*. (F) *G. clandestinus*.



Figs. 84A – D, Aedeagi of *Gymnochthebius* species. (A) *G. chilenus*. (B) *G. clandestinus*, holotype. (C) *G. peruvianus*, holotype. (D) *G. topali*, holotype.

extended from near midlength of anterior lobe of lateral depressions, moderately arcuate to posterior lobe, more markedly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum arcuate. Lateral depressions sparsely finely punctate; anterior lobe wider than long, much larger than posterior lobe, anterior extreme arcuate; posterior lobe angulate, angle nearly right. Pronotum moderately constricted behind lateral depressions. Lateral fossulae deep, microreticulate, inner margin abrupt, outer margin well marked, posterior extreme tapered into lateral hyaline border. Pronotal disc shiny, slightly convex, finely, sparsely punctate, sparsely pubescent. Median groove narrow, shallow, faintly microreticulate. Anterior foveae oval, deep, moderately small, width 0.50 distance between fovea and median groove. anterior foveae deep, length three times width, length three times that of anterior fovea, microreticulate. Posterolateral angles with very shallow impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.16 mm; maximum width (near midlength) 0.80 mm. Disc flat, shiny, with six rows of small, round punctures between suture and humeri, each puncture with a seta. Declivity beginning near posterior 0.33. Intervals flat, width twice puncture width; interstices between punctures 0.25 puncture length. Explanate margin moderately developed. *Abdomen:* Basal four sterna entirely covered with hydrofuge pubescence. Sternum 5 with posterior arc of glabrous area whose anterior limits are near midlength of segment in midline, near posterior angles laterally. Segment 6 shiny, sparsely pubescent. Apical segment shiny; setae of submedian setal group moderately long. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 2.0:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Fig. 84B)(42 examined); female (Fig. 9A).

Natural History. – Other than the descriptor "pond in field", nothing is known of the natural history.

Distribution. – (Figs. 87B,177). Chile.

Etymology. – Latin, *clandestinus* (secret, hidden). I refer to the closely similar external characteristics of adults of *G. clandestinus* to *G. germaini*, *G. chilenus* and *G. tectus*.

7. *Gymnochthebius tectus* new species
(Figs. 9H,83A,87B,88B,177)

Type-locality. – Rio Nirivilo, Maule Province, Chile.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. These specimens were collected by H.P. Brown, November 2, 1971. Data about paratypes (11) are presented in the appendix.

Diagnosis. – Genitalic characteristics must be used to reliably distinguish males of *G. tectus* from those of *G. germaini*, *G. chilenus*, and *G. clandestinus*. Refer to the diagnosis of *G. germaini* for further comments.

Description. – *Form:* Ovate, moderately convex (Fig. 83A). *Size:* Holotype 1.60 mm long, 0.76 mm wide. *Color:* Dorsum and venter dark brown; legs and palpi brown. *Head:* Length 0.32 mm; width 0.44 mm. Frons finely sparsely punctate, microreticulate laterally, very sparsely pubescent; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, finely, moderately sparsely punctate, sparsely pubescent. Labroclypeal suture straight. Labrum length 0.33 width; finely sparsely punctate, sparsely pubescent; median emargination moderately developed; lobes upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, finely sparsely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near anterior 0.33) 0.58 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae. Lateral hyaline border extended posteriorly from near midlength of anterior lobe of lateral depressions, moderately arcuate to posterior lobe, more markedly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum arcuate. Lateral depressions sparsely finely punctate; anterior lobe slightly wider than long, much larger than posterior lobe, anterior extreme arcuate; posterior lobe angulate, angle nearly right. Pronotum moderately constricted behind lateral depressions. Lateral fossulae deep, faintly microreticulate, inner margin abrupt, outer margin well marked, posterior extreme tapered into lateral hyaline border. Pronotal disc shiny, slightly convex, moderately densely, moderately finely punctate, sparsely pubescent. Median groove moderately deep, narrow, faintly microreticulate. Anterior foveae oval, moderately deep, moderately small, width 0.50 distance between fovea and median groove. Posterior foveae moderately deep, narrow, microreticulate, tapered from posterior to anterior, length four times width at base, length twice that of anterior fovea. Posterolateral angles with very shallow impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.08 mm. maximum width (near midlength) 0.76 mm. Disc flat, shiny, with six rows of round punctures between suture and humeri,

each puncture with seta. Declivity beginning near posterior 0.33. Intervals flat, width equal puncture width. Interstices between punctures 0.25 puncture length. Explanate margin moderately developed. *Abdomen:* Basal four sterna entirely covered with hydrofuge pubescence. Sternum 5 with posterior arc of glabrous area with anterior limits near midlength of segment in midline, near posterior angles laterally. Segment 6 shiny, sparsely pubescent. Apical segment shiny; setae of submedian setal groups short. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 2.0/1.0. protarsomeres 1-3 without pads of suction setae. *Genitalia:* Male (Fig. 88B)(2 examined); female (Fig. 9H).

Natural History. – The holotype, allotype and one female paratype were in a series with one specimen of *G. germaini* and 28 specimens of *G. clandestinus*.

Distribution. – (Figs. 87B,177). Chile.

Etymology. – Latin, *tectus* (secret, disguised). I refer to the marked similarity in external features of adults of *G. tectus*, *G. germaini*, *G. chilenus*, and *G. clandestinus*.

8. *Gymnochthebius curvus* new species
(Figs. 9F,85B,86A,87A,177)

Type-locality. – 8 mi. E. of Rio Bueno, Valdivia Province, Chile.

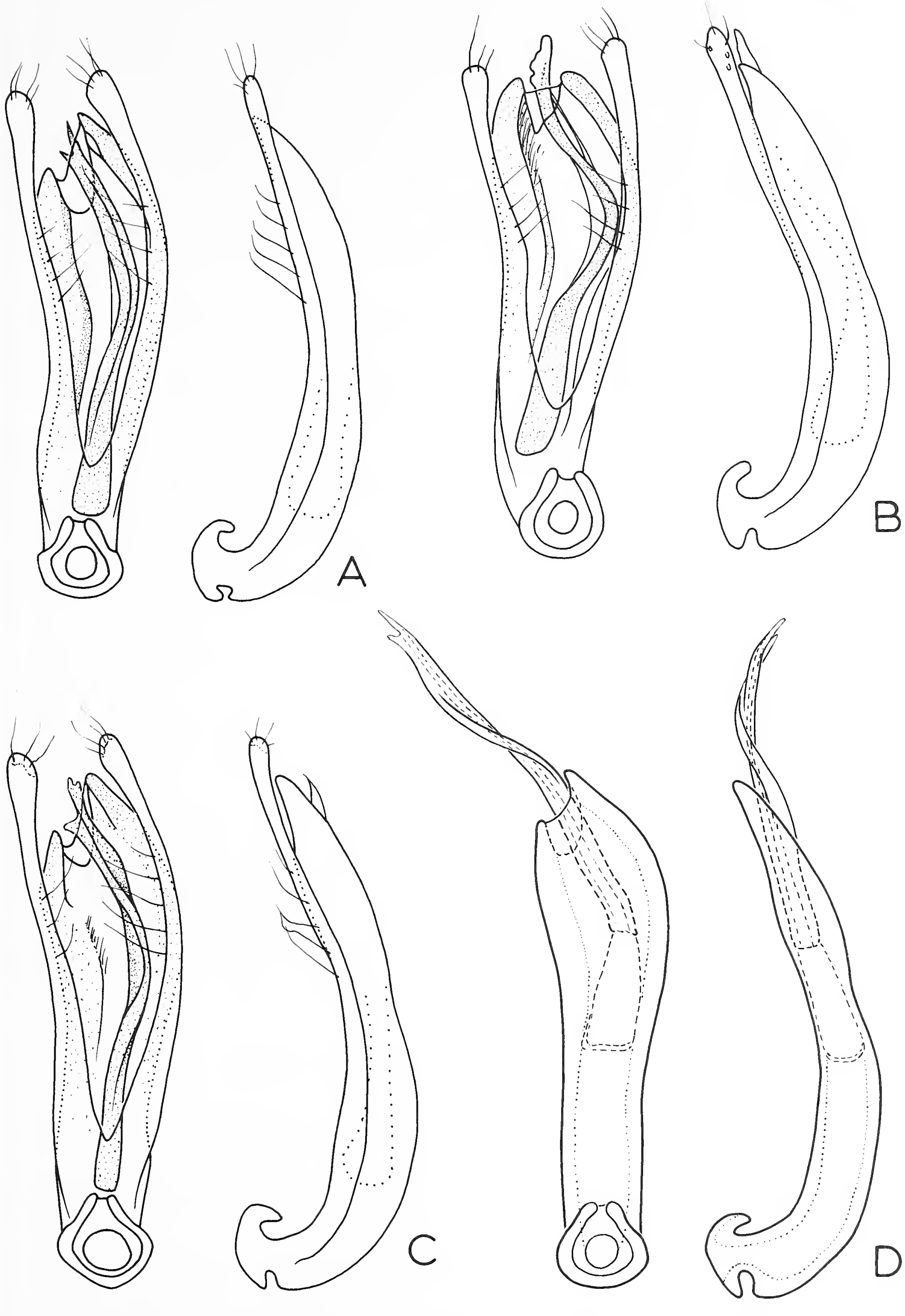
Type-specimens. – The holotype male and allotype with identical locality data are deposited in CAS. Paratypes with same data are in USNM (4) and PDP (2). These specimens were collected by Ross and Michelbacher, January 15, 1951. One paratype, collected by P. and P.Spangler in Orsorno Province, 8 km. S. of Orsorno, June 4, 1969, is deposited in USNM.

Diagnosis. – Relatively convex pronotal reliefs and aedeagal form (Figs. 85B,86A) serve as diagnostic characteristics for *G. curvus*.

Description. – *Form:* Ovate, moderately convex (Fig. 83A). *Size:* Holotype 1.76 mm long, 0.80 mm wide. *Color:* Dorsum and venter dark brown; legs and palpi brown. *Head:* Length 0.34 mm; width 0.46 mm. Frons finely sparsely punctate, very sparsely pubescent; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, finely sparsely punctate, sparsely pubescent, microreticulate laterally. Labroclypeal suture straight. Labrum length 0.33 width; finely sparsely punctate, sparsely pubescent; median emargination slightly developed, edge upturned apparently with low rounded tooth in habitus view. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, finely sparsely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near anterior 0.33) 0.64 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae. Lateral hyaline border extended posteriorly from near midlength of anterior lobe of lateral depressions, moderately arcuate to posterior lobe, more markedly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum arcuate. Lateral depressions nearly impunctate; anterior lobe length equal width, much larger than posterior lobe, anterior extreme arcuate; posterior lobe angulate, angle nearly right. Pronotum moderately constricted behind lateral depressions. Lateral fossulae deep, faintly microreticulate, inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc shiny, moderately convex, finely, sparsely punctate, sparsely pubescent, areas between foveae slightly inflated. Median groove moderately deep, narrow, slightly constricted in midregion, extremely faintly microreticulate. Anterior foveae oval, deep, width slightly greater than distance separating fovea and median groove. Posterior foveae deep, tapered from posterior to anterior, length three times greatest width, length twice that of anterior fovea, extremely faintly microreticulate. Posterolateral angles with very shallow impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.16 mm; maximum width (near midlength) 0.80 mm. Disc flat, shiny, with six rows of round punctures between suture and humeri, each puncture with seta. Declivity beginning near posterior 0.33. Intervals flat, width slightly greater than puncture width; interstices between punctures 0.25 puncture length. Explanate margin moderately developed. *Abdomen:* Basal four sterna entirely covered with hydrofuge pubescence. Sternum 5 pubescent in anterior 0.50, posterior 0.50 glabrous. Segment 6 shiny, sparsely pubescent. Apical segment shiny; setae of submedian setal groups moderately short. *Legs:* All legs moderately long and slender; ratio of hind leg length to abdominal length 1.7:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Fig. 85B)(8 examined); female (Fig. 9F).

Distribution. – (Figs. 87A,177). Southern Chile.

Etymology. – Latin, *curvus* (curved). This is a reference to the two most distinctive features of adults of this species, the markedly arcuate internal tube of the aedeagus and the convex pronotal reliefs.



Figs. 85A – D, Aedeagi of *Gymnochthebius* species. (A) *G. germaini*, variant. (B) *G. curvus*, holotype. (C) *G. germaini*. (D) *G. germaini*, aedeagus with internal tube protruded (parameres omitted).

9. *Gymnochthebius bisagittatus* new species
(Figs. 83E,95B,177)

Type-locality. – 12 km. S. Tocancipa, Cundinamarca Department, Columbia.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. Paratypes with same data are in USNM (10) and PDP (4). One additional paratype, with the following data, is also deposited in USNM: Bogota?, 6–9–36, L.M. Morillo.

Diagnosis. – Pronotal form, especially shape of anterior lobes (Fig. 83E) plus male genitalic characteristics serve to distinguish this species.

Description. – *Form:* Ovate, moderately convex (Fig. 83E). *Size:* Holotype 1.88 mm long, 0.84 mm wide. *Color:* Dorsum and venter dark brown; legs and palpi brown. *Head:* Length 0.36 mm; width 0.50 mm. Frons finely sparsely punctate, very sparsely pubescent. interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, moderately coarsely, moderately densely punctate, sparsely pubescent. Labroclypeal suture straight. Labrum length 0.33 width; finely sparsely punctate, sparsely pubescent; median emargination slightly developed, edge upturned; evenly rounded in habitus view. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 slightly less than 0.50 length of penultimate. Mentum width equal length, shining, finely sparsely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (near anterior 0.33) 0.64 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae. Lateral hyaline border extended posteriorly from base of anterior lobe of lateral depressions, slightly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum slightly arcuate. Lateral depressions deflexed, nearly impunctate; anterior lobe much wider than long, larger than posterior lobe, anterior extreme slightly arcuate; posterior lobe in form of small tooth. Pronotum moderately constricted behind lateral depressions. Lateral fossulae deep, inner margin abrupt, outer margin well demarcated, posterior extreme tapered into lateral hyaline border. Pronotal disc shiny, slightly convex, finely, sparsely punctate, sparsely pubescent. Median goove narrow, shallow, faintly microreticulate. Anterior foveae oval, deep, width equal distance between fovea and median groove. Posterior foveae deep, length three times width, length twice that of anterior fovea, extremely faintly microreticulate. Posterolateral angles lacking shallow impressions. Prosternum with median carina ending at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.24 mm; maximum width (near midlength)0.84 mm. Disc flat, shiny, with six rows of round punctures between suture and humeri, each puncture with seta. Declivity origin near posterior 0.33. Intervals rounded, width equal to puncture width. Interstices between punctures 0.25 puncture length. Explanate margin moderately developed. *Abdomen:* Basal four sterna entirely covered with hydrofuge pubescence. Sternum 5 with posterior arc of glabrous area with anterior limits near midlength of segment in midline, near posterior angles laterally. Segment 6 shiny, sparsely pubescent. Apical segment shiny; setae randomly placed, not in form of discrete submedian rows. *Legs:* All legs moderately long and slender; ratio of hind leg length to abdominal length 1.8:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Fig. 95B)(4 examined).

Distribution. – (Fig. 177). Known only from two localities near Bogota, Colombia.

Etymology. – Latin, *bi* (two) plus *sagittatus* (arrow). This is a reference to shape of anterior lobes of the lateral pronotal depressions, which are reminiscent of broadly rounded, asymmetrical arrowheads.

10. *Gymnochthebius francki* (Bruch)
(Figs. 86C-E,177)

Ochthebius francki Bruch, 1915:464. (lectotype male in ISNB, here designated; type-locality: Parque Saavedra, Buenos Aires, Argentina).

Diagnosis. – Very finely and sparsely punctate pronotum, testaceous elytra, moderately deeply impressed elytral striae, and aedeagal form are the distinctive features of *G. francki.* Adults with pronotal form and sculpture most closely similar to those of *G. francki* is *G. bisagittatus.* Adults of the latter species, however, are uniformly dark brown and have the pronotum shaped slightly differently, especially the anterior lobes (Figs. 83E,86C). *G. francki* is known only from Argentina, whereas *G. bisagittatus* ia presently known only from Colombia.

Description. – *Form:* Ovate, moderately convex (Fig. 86C). *Size:* Lectotype 1.88 mm long, 0.83 mm wide. *Color:* Head dark brown; pronotum and venter brown; elytra, legs, palpi, antennae and elytral epipleura testaceous. *Head:* Length 0.30 mm; width 0.44 mm. Frons finely sparsely punctate, very sparsely pubescent; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, finely sparsely punctate, sparsely pubescent, faintly microreticulate laterally. Labroclypeal suture straight. Labrum length 0.33 width; finely sparsely punctate, sparsely pubescent; median emargination slightly developed, edge upturned; evenly rounded in habitus view. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 nearly 0.66 length of 3. Mentum width equal length, shining, finely sparsely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.42 mm; maximum width (near anterior 0.33) 0.58 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae. Lateral hyaline border extended posteriorly from near midlength of anterior lobe of lateral depressions, straight to posterior angles, very narrow around posterior margin. Anterior margin of pronotum slightly arcuate. Lateral depressions deflexed; nearly impunctate; indentation slight between anterior and posterior lobes; anterior lobe much wider than long, much larger than posterior lobe, anterior extreme arcuate and prominently pubescent; posterior lobe angulate, angle nearly right. Pronotum moderately constricted behind lateral depressions. Lateral fossulae deep, extremely faintly microreticulate, inner margin abrupt, outer margin well marked, posterior extreme tapered into lateral hyaline border. Pronotal disc shiny, very slightly convex, extremely finely, extremely sparsely punctate, sparsely pubescent. Median groove moderately deep, moderately wide, extremely faintly microreticulate. Anterior foveae oval, deep, width equal distance between fovea and median groove. Posterior foveae deep, length three times width, length slightly greaer than twice that of anterior fovea, faintly microreticulate. Posterolateral angles without shallow impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.16 mm; maximum width (near midlength) 0.83 mm. Disc flat, shiny, with six rows of large round punctures between suture and humeri, each puncture with seta. Declivity origin near posterior 0.33. Intervals rounded, slightly elevated, width slightly less than puncture width; interstices between punctures 0.25 puncture length. Explanate margin moderately developed. *Abdomen:* Basal four sterna entirely covered with hydrofuge pubescence. Sternum 5 with posterior arc of glabrous area whose anterior limits are near midlength of segment in midline, near posterior angles laterally. Segment 6 shiny, sparsely pubescent. Apical segment shiny; setae of submedian setal groups moderately short. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.8:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Figs. 86D,E)(2 examined).

Variation. – The single male from Salta is considerably smaller than the lectotype, being 1.68 mm long and 0.80 mm wide. External form and sculpture of this specimen does not differ detectably from that of the lectotype, and the aedeagus (Figs. 86D,E) does not differ significantly. Males of this species are easily discerned, the labrum being upturned along the entire anterior margin which, when seen in habitus view, obscures the small median emargination and results in the anterior edge appearing evenly arcuate. Females have the labrum rather deeply emarginate and lack the markedly upturned margin.

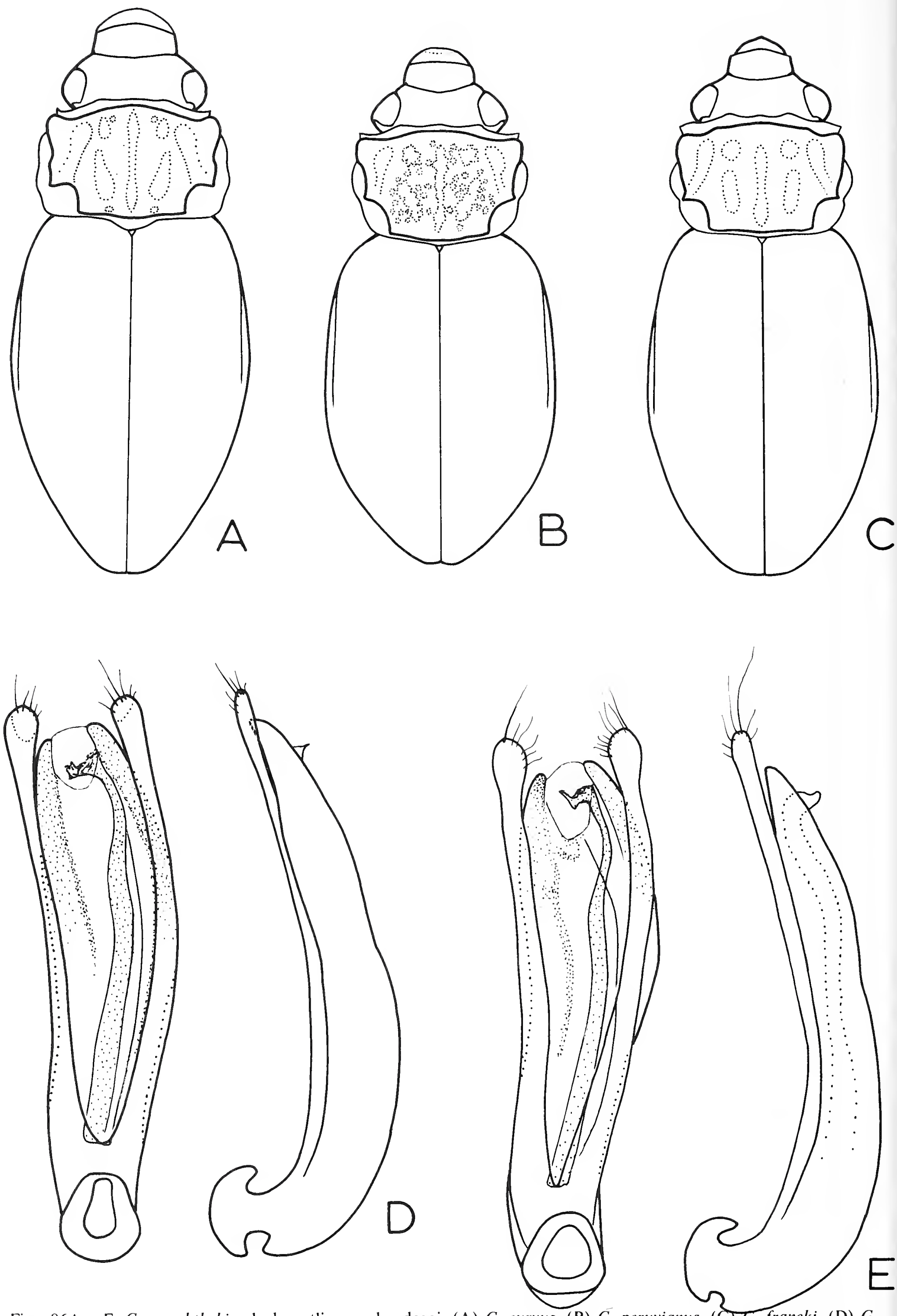
Distribution. – (Fig. 177). Presently known from Buenos Aires (lectotype) and from Salta, Salta Province, Argentina (2 specimens).

11. *Gymnochthebius topali* (J. Balfour-Browne) (Figs. 9B,80D,84D,90B,177)

Ochthebius topali J. Balfour-Browne, 1971:181 (holotype male in HNHM; type-locality: Rio Negro, El Bolson, Argentina).

Diagnosis. – The small pronotum with its slender anterior lobes and very finely microreticulate reliefs, together with the rather deeply emarginate labrum make adults of this species distinctive amongst the group with sternum five partially pubescent (Fig. 80D).

Description. – *Form:* Ovate, moderately convex (Fig. 80D). *Size:* Holotype 1.76 mm long, 0.76 mm wide. *Color:* Dorsum black; venter dark brown; legs and palpi brown. *Head:* Length 0.36 mm; width 0.44 mm. Eyes large. Frons finely sparsely punctate, very sparsely pubescent, finely microreticulate; interocular foveae deep and large, width of each nearly 0.50 distance between them; interocular tuberculi large; basomedial fovea transverse. Frontoclypeal suture markedly arcuate. Clypeus length 0.50 width, finely sparsely punctate, sparsely pubescent, microreticulate laterally. Labroclypeal suture straight. Labrum length 0.33 width; densely pubescent, especially near borders; median emargination markedly developed, depth 0.33 length of labrum, edge slightly upturned; lobes formed by median emargination at slight angle to remainder of labrum. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 slightly less than 0.50 length of 3. Mentum width equal length, shining, finely sparsely punctate; anterior margin arcuate. Submentum evenly, finely



Figs. 86A – E, *Gymnochthebius* body outlines and aedeagi. (A) *G. curvus.* (B) *G. peruvianus.* (C) *G. francki.* (D) *G. francki*, lectotype. (E) *G. francki*, variant from Salta, Argentina.

punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (near anterior 0.33) 0.56 mm. Anterior hyaline border moderately wide in front of disc, wider in front of lateral depressions. Lateral hyaline border origin near anterior 0.33 of anterior lobe of lateral depressions, moderately arcuate to posterior lobe, more markedly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum slightly arcuate. Lateral depressions very finely microreticulate; anterior lobe slightly longer than wide, much larger than posterior lobe, anterior extreme arcuate; posterior lobe angulate, angle nearly right, apex of angle with prominent tooth. Pronotum moderately constricted behind lateral depressions. Lateral fossulae finely microreticulate, moderately deep, inner margin abrupt, posterior extreme extended to lateral hyaline border. Pronotal disc dull, slightly convex, finely, sparsely punctate, finely microreticulate, sparsely pubescent. Median groove moderately deep, moderately wide, microreticulate. Anterior foveae circular, deep, moderately small, width equal distance between fovea and median groove. Posterior foveae deep, length twice width, length twice that of anterior fovea, microreticulate. Posterolateral angles with very shallow impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.08 mm; maximum width (near midlength) 0.76 mm. Disc flat, shiny with six rows of deep, round punctures between suture and humeri, each puncture with seta. Declivity origin near posterior 0.33. Intervals rounded, width 0.33 puncture width; interstices between punctures 0.25 puncture length; explanate margin moderately developed. *Abdomen:* Basal four sterna entirely covered with hydrofuge pubescence. Sternum 5 with posterior arc of glabrous area with anterior limits near midlength of segment in midline, near posterior angles laterally. Segment 6 shiny, sparsely pubescent. Apical segment shiny; setae of submedian setal group of moderate length. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.7:1.0. Protarsomeres 1-3 without pad of suction setae. *Genitalia:* Male (Fig. 84D)(5 examined); female (Fig. 9B)

Variation. – Pronota of many Chilean specimens are more finely microreticulate and have more slender anterior lobes than specimens from Argentina.

Natural History. – J. Balfour-Browne (1971) reports that adults of the large paratype series (149 specimens) were "singled from under stones and mud near stagnant water of Rio Quemquemtrei".

Distribution. – (Figs. 90B,177). Andes mountains of southern Argentina and Chile. I have examined 18 specimens (see appendix).

Remarks. – The aedeagus I have illustrated is from a specimen collected in Chile, Negrete, Bio-Bio. It compares very closely with the holotype, which I have studied.

12. *Gymnochthebius compactus* new species
(Figs. 9D,80F,177)

Type-locality. – Curitiba, Paraná State, Brazil.

Type-specimen. – The holotype female (unique) is deposited in USNM. Paul and Phyllis Spangler collected this specimen, June 28, 1969.

Diagnosis. – Truncate, convex body form, large, deep pronotal foveae, deep elytral punctures, and subcostate elytral intervals serve to characterize adults of this distinctive species (Fig. 80F).

Description. – *Form:* Convex, ovate (Fig. 80F). *Size:* Holotype 1.60 mm long, 0.80 mm wide. *Color:* Dorsum and venter dark brown; legs and palpi brown. *Head:* Length 0.36 mm; width 0.46 mm. Frons finely sparsely punctate, very sparsely pubescent; interocular foveae deep and large, width of each nearly 0.66 distance separating them; interocular tuberculi large; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, finely sparsely punctate, sparsely pubescent, faintly microreticulate basally and laterally. Labroclypeal suture straight. Labrum length 0.50 width; finely sparsely punctate, sparsely pubescent; anterior margin straight, extremely slightly upturned in midregion. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, finely sparsely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near anterior 0.33) 0.68 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae. Lateral hyaline border origin near midlength of anterior lobe of lateral depressions, moderately arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum arcuate. Lateral depressions nearly impunctate; anterior lobe width equal length, larger than posterior lobe, anterior extreme arcuate; posterior lobe angulate, angle nearly right. Pronotum moderately constricted behind lateral depressions. Lateral fossulae deep, microreticulate, inner margin abrupt, outer margin well demarcated, posterior extreme extended to lateral hyaline border. Pronotal disc

shiny, strongly convex, extremely finely, extremely sparsely punctate, sparsely pubescent, areas between median groove and foveae inflated. Median groove narrow, moderately deep, slightly constricted in midregion, faintly microreticulate. Anterior foveae oval, very deep, width equal distance between fovea and median groove. Posterior foveae deep, length three times width, length twice that of anterior fovea, extremely faintly microreticulate. Posterolateral angles with very shallow impressions. Prosternum with median carina ending at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.08 mm; maximum width (near midlength) 0.80 mm. Disc convex, shiny, with six rows of round punctures between suture and humeri, each puncture with seta. Declivity origin near midlength of elytra. Intervals rounded, slightly elevated, width equal puncture width. Interstices between punctures 0.25 puncture length. Explanate margin moderately developed. *Abdomen:* Basal four sterna entirely covered with hydrofuge pubescence. Sternum 5 glabrous in apical 0.66. Sternum 6 shiny, sparsely pubescent. *Legs:* All legs moderately short and stout; ratio of hind leg length to abdominal length 1.6:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Female (Fig. 9D)(1 examined); male unknown.

Distribution. – (Fig. 177). Known only from the type-locality.

Etymology. – Latin, *compactus* (compact). This is a reference to the body form.

13. *Gymnochthebius peruvianus* (J. Balfour-Browne) (Figs. 50A,84C,86B,177)

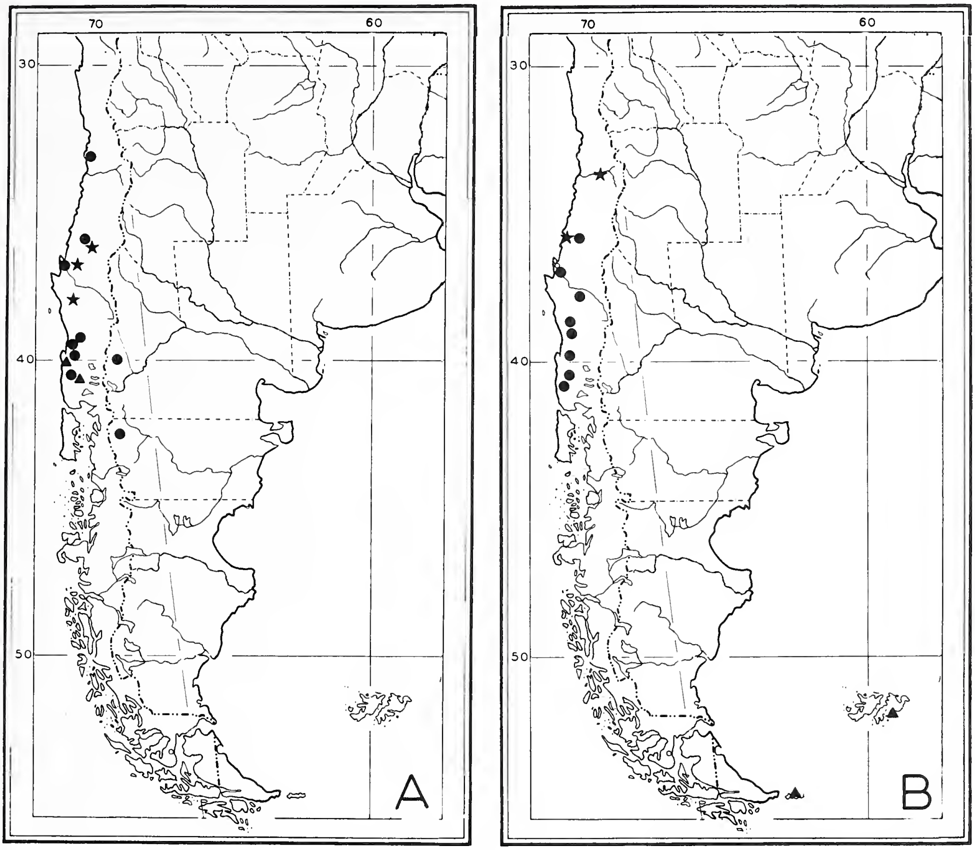
Ochthebius peruvianus J. Balfour-Browne, 1971:182 (holotype male in BMNH; type-locality: Villa (cerca Lima), Peru).

Diagnosis. – Coarsely puncate pronotum, deeply impressed elytral striae and pale elytral coloration serve as diagnostic characteristics for adults of this distinctive species (Fig. 86B).

Description. – *Form:* Ovate, moderately convex (Fig. 86D). *Size:* Holotype 1.68 mm long, 0.80 mm wide. *Color:* Head, pronotum and venter dark brown; elytron testaceous except for illdefined dark band extended nearly entire length in midregion; legs, palpi and elytral epipleura testaceous. *Head:* Length 0.32 mm; width 0.44 mm. Frons coarsely, densely punctate, very sparsely pubescent; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, coarsely densely punctate, sparsely pubescent, microreticulate laterally. Labroclypeal suture straight. Labrum length 0.33 width; finely sparsely punctate, sparsely pubescent; median emargination weakly developed, edge upturned; evenly rounded in habitus view. Maxillary palpus with palpomere 3 moderately wide; ultimate segment slightly greater than 0.50 length of penultimate. Mentum width equal length, shining, finely sparsely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near anterior 0.33) 0.60 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae. Lateral hyaline border origin near midlength of anterior lobe of lateral depressions, moderately arcuate to posterior lobe, more markedly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum arcuate. Lateral depressions coarsely punctate; anterior lobe wider than long, much larger than posterior lobe, anterior extreme arcuate; posterior lobe angulate, angle nearly right, small tooth at apex. Pronotum moderately constricted behind lateral depressions. Lateral fossulae deep, very faintly microreticulate and punctate, inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc shiny, slightly convex, coarsely densely punctate, sparsely pubescent. Median groove moderately deep, narrow, outline somewhat irregular, with large punctures. Anterior foveae faintly microreticulate, circular, deep, width equal distance between fovea and median groove, outline somewhat irregular, large punctures at periphery. Posterior foveae deep, length twice width, length twice that of anterior fovea, outline irregular, large punctures at periphery. Posterolateral angles with very shallow impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.08 mm; maximum width (near midlength)0.80 mm. Disc flat, shiny, with 6 striate rows of large round punctures between suture and humeri, each puncture with seta. Declivity origin near posterior 0.33. Intervals rounded, slightly elevated, width slightly less than puncture length. Explanate margin moderately developed. *Abdomen:* Basal four sterna entirely covered with hydrofuge pubescence. Segment 5 pubescent in anterior 0.50, posterior 0.50 glabrous. Segment 6 shiny, sparsely pubescent. Apical segment shiny; setae of submedian setal groups short. *Legs:* All legs moderately long and slender; ratio of hind leg length to abdominal length 1.7:1.0 Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Fig. 84C)(2 examined).

Distribution. – (Figs. 50A,177). Known only from the type–locality near Lima and from 10 km. S. of Chiclayo, Lambayeque Department, Peru.

Remarks. – My measurements of the holotype are less than those indicated by J. Balfour-Browne (1971) (1.68 x 0.80 vs. 1.85 x 0.87). I have not seen the two female paratypes he designated.



Figs. 87A – B, Geographical distributions. (A) *Gymnochthebius germaini* ●, *G. chilenus* ★ and *G. curvus* ▲. (B) *Gymnochthebius clandestinus* ●, *G. tectus* ★ and *Meropathus vectis* ▲.

14. *Gymnochthebius bartyrae* new species
(Figs. 9C,50A,80B,95A,177)

Type-locality. – Rio Blanco, Quebrada Copa, Lima Department, Peru.

Type-specimens. – Holotype male and allotype, with identical locality data, are deposited in MSP. Hans and Bartyra Reichardt collected these specimens, together with three paratypes (1 USNM; 2 PDP), November 1, 1974. One paratype, with the following data, is deposited in CAS: 5 mi. NE Cerro de Pasco, 3,500 meters, 29–12–54, Schlinger and Ross.

Diagnosis. – The shiny, mottled elytra and unusual pronotal form (Fig. 80B) of adults make *G. bartyrae* one of the most distinctive members of the *germaini* Group. The pronotal disc is quite convex, contrasting remarkably with the very flat, broad lateral depressions. The pronotal foveae and median groove are large, deeply impressed and markedly microreticulate. The sides of the pronotum are rather markedly convergent to the base, giving the pronotum a subtriangular appearance.

Description. – *Form:* Moderately elongate; rather convex transversely, only moderately convex longitudinally (Fig. 80B). *Size:* Holotype 1.84 mm long, 0.80 mm wide. *Color:* Head, pronotum and venter dark brown; elytra with dark and light brown mottlings; legs and palpi brown. *Head:* Length 0.36 mm; width 0.46 mm. Frons markedly microreticulate over entire surface, very sparsely pubescent; interocular foveae deep and large, width of each nearly equal to distance between them; interocular tuberculi large; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, markedly microreticulate. Labroclypeal suture straight. Labrum length 0.33 width; markedly microreticulate, sparsely pubescent; median emargination moderately developed; lobes upturned very slightly. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 slightly less an 0.50 length of penultimate. Mentum width equal length, shining, finely sparsely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.42 mm; maximum width (near anterior angles) 0.58 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae. Lateral hyaline border origin near midlength of anterior lobe of lateral depressions, extended straight to posterior angles, very narrow around posterior margin. Anterior margin of pronotum arcuate. Lateral depressions flat, markedly microreticulate; anterior lobe slightly developed, much wider than long, larger than posterior lobe, anterior extreme arcuate; posterior lobe ngulate, angle nearly right. Pronotum moderately constricted behind lateral depressions. Lateral fossulae deep, inner margin vertical, outer margin indistinguishable from remainder of lateral depression. Pronotal disc very convex, dull, markedly microreticulate except small area between anterior and posterior foveae of a side; areas between median groove and foveae inflated. Median groove deep and wide, especially in anterior 0.50, latter twice width of posterior 0.50, markedly microreticulate. Anterior foveae oval, deep, microreticulate, width equal distance between fovea and median groove. Posterior foveae very deep, length twice width, length twice that of anterior fovea, markedly microreticulate. Posterolateral angles lacking shallow impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with very large median glabrous area. *Elytra:* Length 1.20 mm. maximum width (near midlength) 0.80 mm. Disc flat, depression in midregion, shiny, with six rows of small round punctures between suture and humeri, each puncture with seta. Declivity origin near posterior 0.33. Intervals flat, width three times puncture width. Interstices between punctures equal to puncture length. Explanate margin moderately developed. *Abdomen:* Basal four sterna covered with hydrofuge pubescence. Sternum 5 with posterior arc of glabrous area with anterior limits near anterior 0.33 of segment in midline, near posterior angles laterally. Segment 6 shiny, sparsely pubescent. Apical segment shiny; setae of submedian setal groups short. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.8:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Fig. 95A)(2 examined); female (Fig. 9C).

Natural History. – Hans Reichardt wrote (in litt.) that the holotype and its series were "collected in a more or less hygropetric habitat, in cold water", on km 103 of the Carretera Central, at an elevation of 3,400 meters.

Distribution. – (Figs. 50A,177). Known only from two localities near Lima, Peru.

Etymology. – I am pleased to acknowledge the request of the late Hans Reichardt, and dedicate this new species to his wife, Bartyra.

The *reticulatus* Subgroup

Adults of the *reticulatus* Subgroup are characterized by very well developed dorsal microreticulation, large size and convex body form. The aedeagus is straight and nearly symmetrical in dorsal view, with the parameres dorsal to the median portion, not at the sides. Only two rather closely related species are currently known for this subgroup.

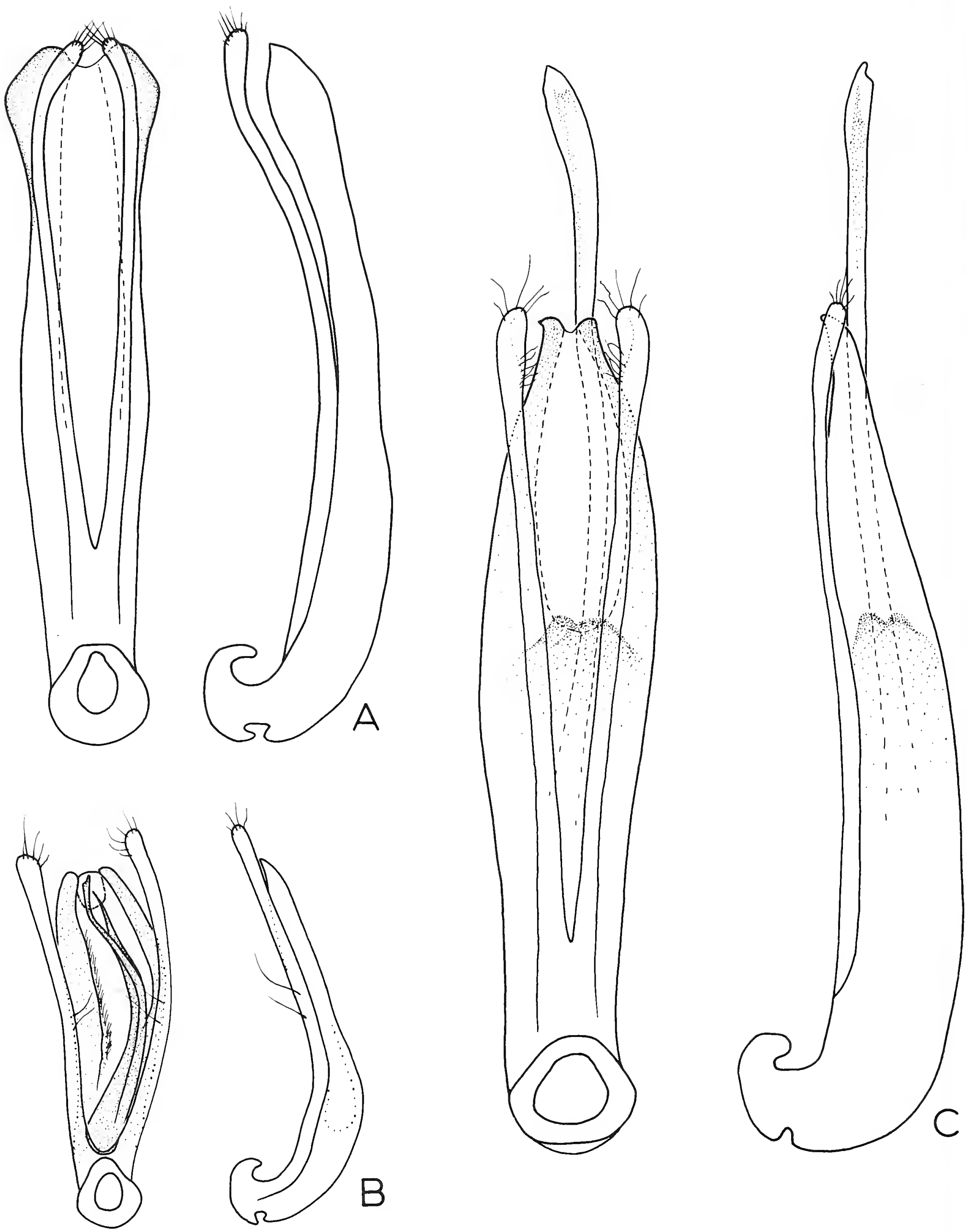
15. *Gymnochthebius reticulatus* (d'Orchymont)
(Figs. 80C,88A,90B)

Ochthebius reticulatus d'Orchymont, 1943:45 (holotype male deposited in ISNB; type–locality: Hornadita, Jujuy Province, Argentina).

Diagnosis. – Large size, convey form and microreticulate pronotum (Fig. 80C) readily distinguish adults of this species from those of others in the subgenus which likewise have sternum 5 partially hydrofuge pubescent and the metasternum with a large glabrous area, except *G. reticulatissimus.* Adults differ from those of the latter in having: 1) elytra striate with intervals rounded instead of costate; 2) dorsal microreticulation less developed, especially on elytra and pronotal disc, the former quite shiny and the latter slightly shiny relative to the more markedly microreticulate remainder of the pronotum; 3) punctation of the pronotum and head less well developed, especially evident on the shiny, non–microreticulate area on the clypeus; 4) the anterior lobes of the pronotum more prominent; and 5) different aedeagal form (Figs. 88A,C).

Description. – *Form:* Broadly ovate, very convex (Fig. 80C). *Size:* Holotype 2.08 mm long, 0.98 mm wide. *Color:* Brown, head slightly darker; pronotum with faint metallic reflections. *Head:* Length 0.40 mm; width 0.54 mm. Frons markedly microreticulate, finely sparsely punctate, very sparsely pubescent; interocular foveae moderately deep and large, width of each nearly 0.50 distance between them; interocular tuberculi small; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, width, finely sparsely punctate; sides and basal 0.50 microreticulate and dull, remainder shiny and non– microreticulate. Labroclypeal suture straight. Labrum length 0.33 width; densely, moderately coarsely punctate, sparsely pubescent; median emargination well developed; lobes upturned, at angle to remainder of labrum. Maxillary palpus with penultimate 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, moderately densely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.48 mm; maximum width (near anterior 0.33) 0.76 mm. Anterior hyaline border narrow in front of disc, slightly wider in front of lateral fossulae. Lateral hyaline border wide, origin near base of anterior lobe, more markedly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum straight in midregion. Lateral depressions markedly microreticulate, without apparent punctation; anterior lobe well produced, acute at apex, tapered gradually into posterior lobe; posterior lobe with small tooth at apex. Pronotum moderately constricted behind lateral depressions. Lateral fossulae deep, markedly microreticulate; inner margin abrupt, outer margin ill–defined. Pronotal disc microreticulate, but effacedly so, distinctly more reflective than remainder of pronotum, convex, finely sparsely punctate, non–pubescent. Median groove deep, moderately wide, slightly constricted in midregion, markedly microreticulate. Anterior foveae very deep, oval, width equal distance between fovea and median groove, markedly microreticulate. Posterior foveae moderately deep, length three times width, length twice that of anterior foveae, markedly microreticulate. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.36 mm; maximum width (near midlength)0.98 mm. Disc convex, shiny, with six rows of punctures in shallow furrows between suture and humeri. Declivity origin near posterior 0.33. Intervals rounded, not costate, width slightly greater than puncture width, with very fine impressions. Interstices between punctures reduced to narrow walls. Explanate margin well developed. *Abdomen:* Basal four sterna entirely covered with hydrofuge pubescence. Sternum 5 with posterior arc of grabrous area with anterior limits near midlength of segment in midline, near posterior angles laterally. Segment 6 shiny, sparsely pubescent. Apical segment shiny, sparsely pubescent, hairs not in discrete groups. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.8:1.0. Protarsomeres 1–3 without suction setae. *Genitalia:* Male (Fig. 88A)(1 examined); female unknown.

Natural History. – The holotype and paratype were collected at 3,400 and 3,700 meters, respectively. Nothing else is known of the habitat.



Figs. 88A – C, Aedeagi of *Gymnochthebius* holotypes. (A) *G. reticulatus*. (B) *G. tectus*. (C) *G. reticulatissimus*.

Distribution. – (Fig. 90B). Presently known only from the type– locality in Argentina and by one male paratype, which I have not seen, from Cueva Iturbe in the same province (d'Orchymont, 1943).

Remarks. – The aedeagus of the holotype (Fig. 88A) appears to lack the internal tube characteristic of other *Gymnochthebius* males. Indeed, the marked development of the internal tube of males of *G. reticulatissimus* (Fig. 88C), the sister-species of *reticulatus*, leads me to suspect that perhaps the internal tube of the holotype was inadvertently pulled from the aedeagus proper during dissection, which was performed by a previous worker. Confirmation of the internal aedeagal form must await availability of additional specimens.

16. *Gymnochthebius reticulatissimus* new species
(Figs. 80A,88C,90B)

Type-locality. – 15 km. W. Tucuman, Tucuman, Argentina.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. These specimens, presently the only known, were collected by Paul and Phyllis Spangler, May 22, 1969.

Diagnosis. – Among those species in the subgenus *Gymnochthebius* characterized by sternum 5 partially hydrofuge pubescent and the metasternum with a median glabrous area, adults of *G. reticulatissimus* are distinguished by large, convex form, coarsely microreticulate dorsum, costate elytral intervals and pronotal form (Fig. 80A). From adults of its putative sister-species, *G. reticulatus*, adults of *G. reticulatissimus* differ in possession of costate elytral intervals, more markedly developed punctation of the pronotum, head and dorsal microreticulation in general, and aedeagal form (Figs. 88A,C). Refer to the diagnosis of *G. reticulatus* for further comments.

Description. – *Form:* Broadly ovate, very convex (Fig. 80A). *Size:* Holotype 2.12 mm long, 1.08 mm wide. *Color:* Brown; pronotum with faint gold-green iridescence. *Head:* Length 0.48 mm; width 0.58 mm. Frons markedly microreticulate, finely sparsely punctate, very sparsely pubescent; interocular foveae moderately deep and large, width of each nearly 0.50 distance between them; interocular tuberculi indistinct; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, finely, moderately densely punctate; anterior 0.50 shiny, without microreticulation; posterior 0.50 dull, with well developed microreticulation; very sparsely pubescent. Labroclypeal suture straight. Labrum length 0.33 width; densely, moderately coarsely punctate, sparsely pubescent; median emargination well developed; lobes upturned, at angle to remainder of labrum. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.25 length of 3. Mentum width equal length, shining, densely, coarsely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.50 mm; maximum width (near anterior 0.33) 0.80 mm. Anterior hyaline border narrow in front of disc, slightly wider in front of lateral fossulae. Lateral hyaline border wide, origin at small tooth near base of anterior lobe of lateral depressions, moderately arcuate to posterior lobe, more markedly arcuate 'to posterior angles, very narrow around posterior margin. Anterior margin of pronotum straight in midregion. Lateral depressions markedly microreticulate, densely, moderately coarsely punctate; anterior lobe wider than long, much larger than posterior lobe, anterior extreme arcuate; posterior lobe angulate, angle nearly right, with small tooth at apex. Pronotum moderately constricted behind lateral depressions. Lateral fossulae deep, markedly microreticulate, inner margin abrupt, outer margin illdefined, posterior extreme extended to lateral hyaline border. Pronotal disc dull, strongly microreticulate, convex, finely, moderately densely punctate, non–pubescent. Median groove deep, moderately wide, slightly constricted in midregion, markedly microreticulate. Anterior foveae deep, oval, width slightly less than distance between fovea and median groove, markedly microreticulate. Posterior foveae deep, length three times width, length twice that of anterior fovea, markedly microreticulate. Posterolateral angles with deep impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area densely, finely punctate. *Elytra:* Length 1.42 mm; maximum width (near midlength)1.08 mm. Disc convex, dull, with six rows of ill-defined punctures in deep furrows between suture and humeri. Furrows markedly microreticulate. Declivity origin near posterior 0.33. Intervals costate, width slightly less than furrow width, weakly microreticulate. Explanate margin well developed. *Abdomen:* Basal four sterna covered with hydrofuge pubescence. Sternum 5 with posterior arc of glabrous area with anterior limits near midlength of segment in midline, near posterior angles laterally. Segment 6 shiny, sparsely pubescent. Apical segment shiny; setae of submedian

setal groups in patches, not in discrete rows. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.8:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Fig. 88C)(1 examined).

Distribution. – Known only from the type–locality in Tucuman Province, Argentina.

Etymology. – Latin *reticulatus* (netlike) plus adjectival superlative *issimus* (most). Named in reference to the very well developed dorsal microreticulation.

Remarks. – A notable morphological feature, which appears to be unique to this species, is form of the anterior extremes of the lateral hyaline borders where they join the pronotum proper. In this region the usually transparent borders are thickened and darkly colored to produce a small, acute process on either side of the pronotum.

The *nitidus* Group

This group consists of moderate to small sized, generally smooth species which lack hydrofuge pubescence on sternum 5. Adults of six of the species have a similar habitus, with more or less well developed digitiform anterior lobes of the pronotum, but differ from one another in various characters which are discussed in the keys and elsewhere. The remaining two species form a discrete subunit by virtue of small, truncate appearance, costate or subcostate elytra and in the form of the lateral pronotal depressions which have the posterior lobes larger than the anterior. This is opposite the condition seen in the remainder of the genus. I feel, however, that giving these two species, *G. oppositus* and *G. seminole* , separate formal taxonomic status would not be useful at this time. *G. fossatus* has a remarkably extensive distribution, ranging from southern United States to Argentina. The remaining species in the group are not known outside the north–south boundaries of southern Canada and Costa Rica, although I suspect some Central and South American species remain to be discovered.

The *nitidus* Subgroup

Members of this subgroup are characterized by presence of well developed rows of punctures on the elytra. They have all four pronotal foveae, and the body is generally of moderate size and convexity.

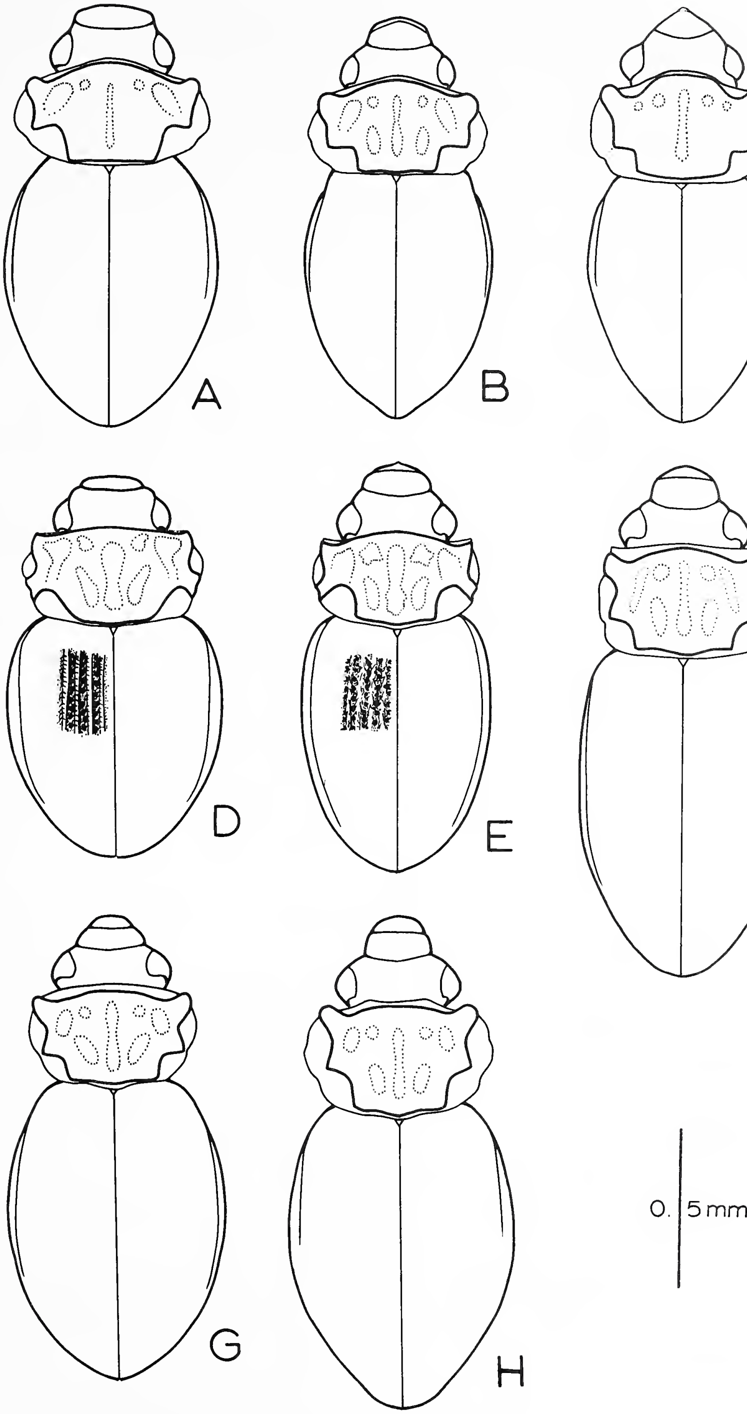
One species (*G. fossatus*) ranges from the United States south to Argentina. The other two species currently known for the subgroup are represented in northeastern United States and adjacent Canada (*G. nitidus*), and southcentral United States (*G. falli*).

Habitat data suggest that these species are principally adapted to lotic habitats.

17. *Gymnochthebius nitidus* (LeConte)
(Figs. 89H,90A,93D,F,96B,179)

Ochthebius nitidus LeConte, 1850:217. (holotype female in MCZ; type-locality: Eagle Harbor, Keweenaw County, Michigan). – LeConte, 1855:361. – LeConte,1878:378. – Horn,1890:22. – Blatchley, 1910:253. – d'Orchymont,1943:37.

Diagnosis. – Adults of this species are easily confused with those of two other members of the *nitidus* Subgroup which have digitiform anterior lobes of the lateral depressions: *G. fossatus* and *G. falli*. *G. nitidus* adults are more convex than are those of either of these two species, especially the elytra. This difference is most striking between *G. nitidus* and *G. falli*;



Figs. 89A – H, *Gymnochthebius* body outlines. (A) *G. maureenae*. (B) *G. perlabidus*. (C) *G. laevipennis*. (D) *G. seminole*. (E) *G. oppositus*. (F) *G. falli*. (G) *G. fossatus*. (H) *G. nitidus*.

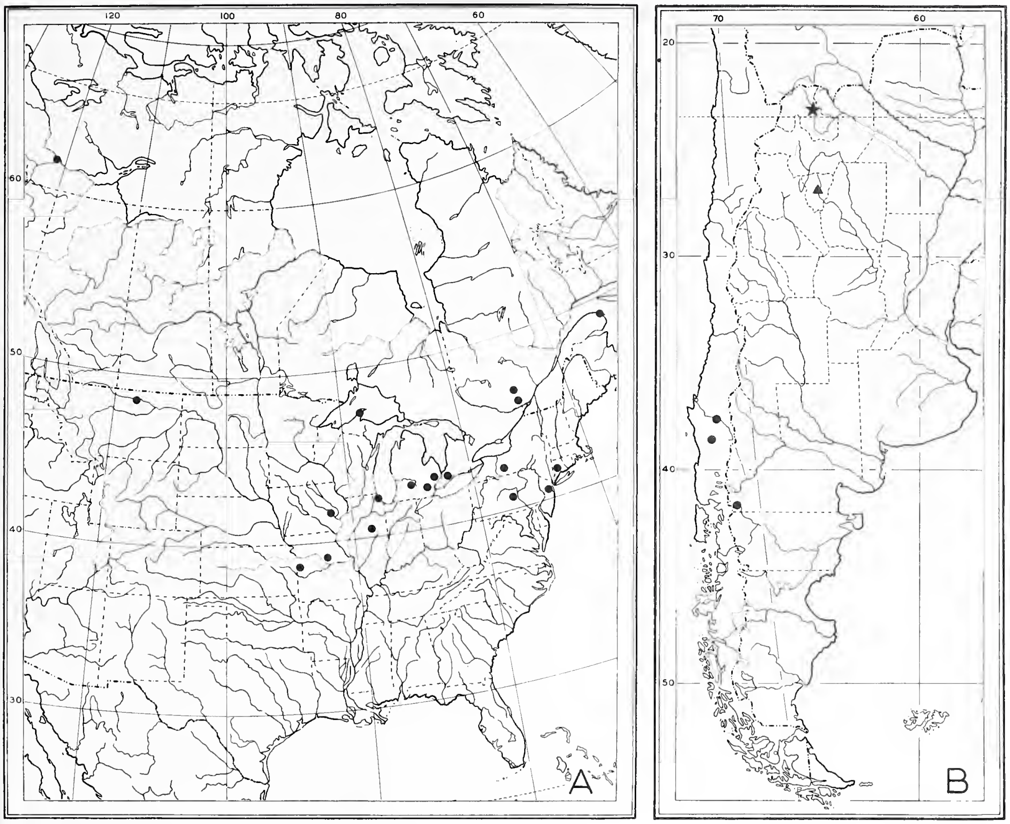
the latter are also larger (males ca. 1.70 mm vs. 1.24 mm), with narrower hyaline border, and generally have lighter colored elytra which contrast with the darker pronotum, whereas *G. nitidus* adults are uniformly dark brown. These size and color differences do not occur constantly between *G. nitidus* and *G. fossatus*, however. Their allopatric distributions will be an aid in making determinations: *G. nitidus* is a temperate species, found in Canada and northeastern United states; *G. fossatus* is essentially a tropical species, its distribution ranging from southern United States to Central and South America. For further comment on these three species, refer to the diagnoses of *G. falli* and *G. fossatus*.

Description. – *Form:* Moderately convex, ovate (Fig. 89H). *Size:* Holotype 1.24 mm long, 0.72 mm wide. *Head:* Length 0.28 mm; width 0.40 mm Frons finely sparsely punctate, very sparsely pubescent; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, extremely finely microreticulate, sparsely pubescent. Labroclypeal suture straight. Labrum length 0.33 width; finely sparsely punctate, sparsely pubescent; median emargination weakly developed. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.66 length of 3. Mentum width equal length, shining, finely sparsely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum (Fig. 96B) length at midline 0.36 mm; maximum width (near anterior 0.33) 0.60 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae. Lateral hyaline border very wide, origin near apex of anterior lobe of lateral depressions, moderately arcuate to posterior lobe, moderately arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum slightly arcuate in midregion. Lateral depressions nearly impunctate; anterior lobe slightly longer than wide, distinctly larger than posterior lobe, anterior extreme arcuate; posterior lobe angulate, angle nearly right. Pronotum moderately constricted behind lateral depressions. Lateral fossulae deep, oval, length equal distance from posterior margin of fossula to margin of pronotum. Pronotal disc shiny, convex, extremely finely, extremely sparsely punctate, sparsely pubescent. Median groove moderately deep, narrow, slightly constricted in midregion, extremely faintly microreticulate. Anterior foveae circular, deep, moderately small, width equal distance between fovea and median groove. Posterior foveae deep, length twice width, length twice that of anterior fovea, extremely faintly microreticulate. Posterolateral angles with very shallow impressions. Prosternum with median carina ending at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 0.96 mm; maximum width (near midlength)0.72 mm. Disc convex, shiny, with six rows of round punctures between suture and humeri. Sides convex. Elytra very slightly peaked at point where declivity begins, near posterior 0.33; intervals flat, width slightly greater than puncture width; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal four sterna with hydrofuge pubescence. Segments 5 and 6 shiny, sparsely pubescent. Apical segment shiny. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.8:1.0. Protarsomeres 1–3 without suction setae. *Genitalia:* Male (Figs. 93D,F)(6 examined).

Variation. – Other than slight aedeagal variation which I have illustrated (Figs. 93D,F), no noteworthy variation was seen in the 61 specimens studied.

Distribution. – (Figs. 90A,179). Most specimens have been collected in northeastern United States and adjacent areas of Canada. Two isolated localities, northern Montana and Ft. Simpson Northwest Territories, indicates, however, that this species is trans-Canadian, and might be Holarctic. If so, *G. nitidus* would be the only species of *Gymnochthebius* to be so distributed. Further, its stem-species could have served as the 'reservoir' for allopatric speciation of *Gymnochthebius* in the Palearctic Region. Two specimens have been found as far south as Missouri. I have examined 61 specimens (see appendix).

Remarks. – Males have the labrum very slightly emarginate, with the emargination distinctly upturned, but not in form of a dentiform process. Viewed from above, the anterior margin appears evenly rounded, the upturned edge not apparent in outline. A tangential view of the head displays the upturned edge nicely. Females have the labral emargination deeper and lack the upturned edge. The holotype has the following labels: (blue disc turned gray–green)/ Type 313/ *O. nitidus* Lec.



Figs. 90A – B, Geographical distributions of *Gymnochthebius* species. (A) *G. nitidus*. (B) *G. topali* ●, *G. reticulatus* ★ and *G. reticulatissimus* ▲.

18. *Gymnochthebius fossatus* (LeConte) (Figs. 89G,91A-F,92B,179)

Ochthebius fossatus Leconte, 1855:362 (holotype male deposited in MCZ; type-locality: Colorado River, California, U.S.A.). – LeConte, 1878:380. – Horn, 1890:22. – Fall, 1919:213. – Leech and Chandler, 1956:333.

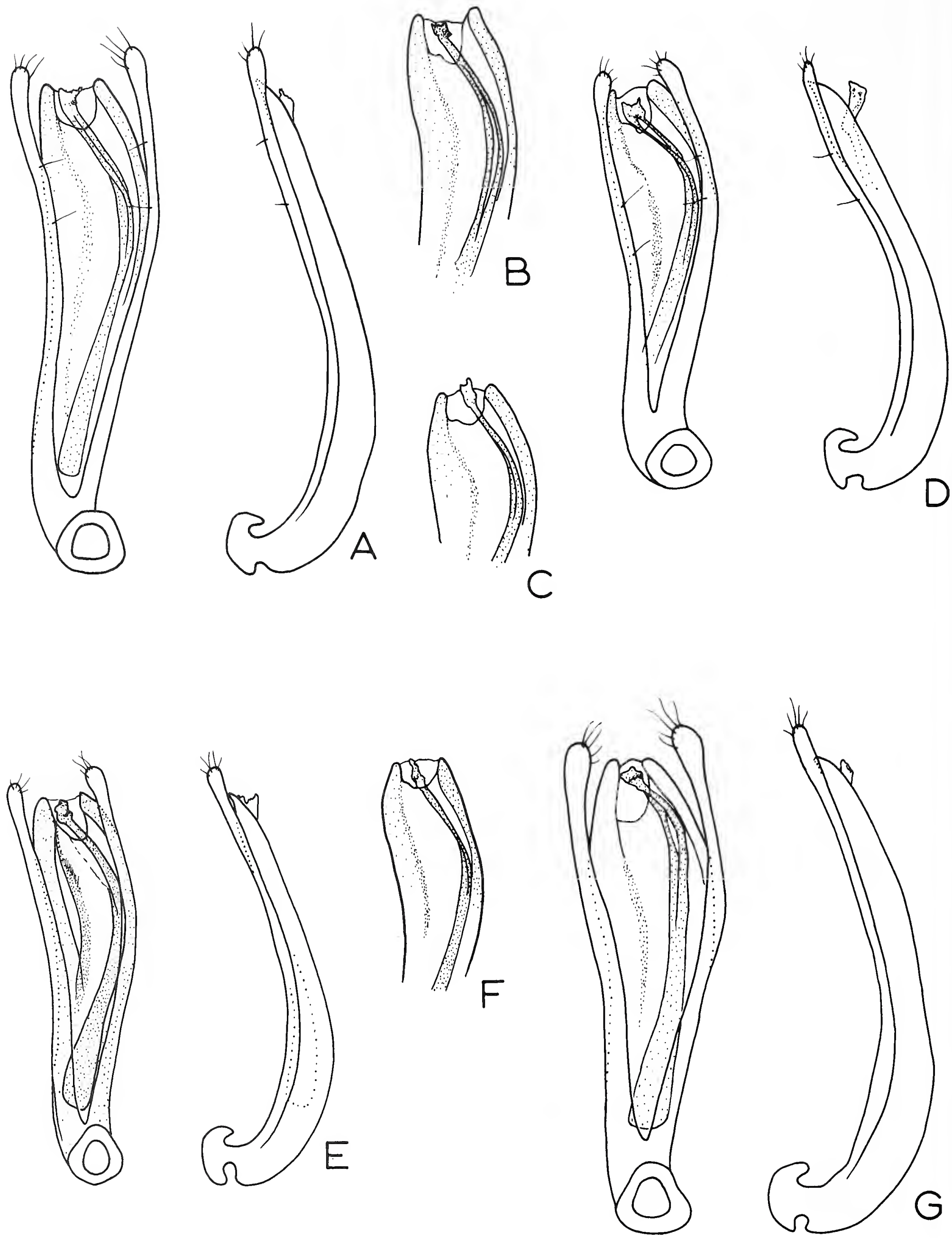
Ochthebius tuberculatus LeConte, 1878:380 (holotype male deposited in MCZ; type-locality: New Mexico, U.S.A.). – Horn, 1890:22. – Fall, 1919:213.

Ochthebius foveicollis LeConte, 1878:381 (lectotype male deposited in MCZ, here designated; type-locality: Enterprise, Florida, U.S.A.). – Horn, 1890:20. – Fall, 1919:213.

Ochthebius parvulus Sharp, 1882:91 (lectotype female deposited in BMNH, here designated; type-locality: Guanajuato, Mexico; new synonomy). – d'Orchymont, 1943:43.

Ochthebius nitiduloides d'Orchymont, 1943:43 (holotype male deposited in ISNB; type-locality: Pernambuco, Brazil; new synonomy).

Sharp's type-specimen and d'Orchymont's type-specimen do not differ significantly from LeConte's type–specimen. Refer to the diagnosis and remarks sections for additional comments.



Figs. 91A – G, Aedeagi of *Gymnochthebius* species. (A) *G. fossatus*, specimen from Brownsville, Texas. (B) *G. fossatus*, Chapingo, Mexico, Mexico. (C) *G. fossatus*, Texcoco, Mexico, Mexico. (D) *G. fossatus*, Enterprise, Florida. (E) *G. fossatus*, Goias, Brazil. (F) *G. fossatus*, Pernambuco, Brazil (drawn from holotype of *G. nitiduloides* d'Orchymont). (G) *G. falli*, holotype.

Diagnosis. – Adults of this species are easily confused with those of *G. nitidus* and *G. falli*. Refer to the diagnoses of those species for comments regarding external characteristics. The genitalia of *G. nitidus* males (Fig. 93D) are short, wide and with a general configuration that is clearly discernible from those of *G. fossatus* and *G. falli* (Figs. 91A,G) males. The aedeagus of *G. falli* males is somewhat broader than that of *G. fossatus* and the apex tapers more toward the tip, resulting in a constricted appearance when compared with *G. fossatus*. As a result of this tapering, width of the apical opening is less than width of a paramere at its apex in *G. falli*; in *G. fossatus* the apical opening is twice the width of a paramere at its apex. Additionally, the internal duct has its bend consistently near the apical 0.33 of the aedeagus in *G. fossatus*, whereas this bend is consistently near the apical 0.17 in *G. falli*. The consistency of 1) shape of the apex; 2) arc of the internal duct; 3) general curve of the median lobe; and 4) external characteristics; plus widespread geographical distribution are the primary reasons that *G. parvulus* and *G. nitiduloides* are regarded as conspecific with *G. fossatus*, and their names are here synonymized.

Description. – *Form:* Subovate, slightly convex (Fig. 89G). *Size:* Holotype male 1.26 mm long, 0.64 mm wide. *Color:* Legs, palpi and elytral epipleura light brown, remainder dark brown. *Head:* Length 0.28 mm; width 0.39 mm. Frons finely sparsely punctate, very sparsely pubescent; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, finely sparsely punctate, sparsely pubescent. Labroclypeal suture straight. Labrum length 0.33 width; finely sparsely punctate, sparsely pubescent; median emargination slightly developed, edge upturned; labrum evenly rounded in habitus view. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 slightly greater than 0.50 length of 3. Mentum width equal length, shining, finely sparsely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.34 mm. maximum width (near anterior 0.33) 0.52 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae. Lateral hyaline border origin near midlength of anterior lobe of lateral depressions, moderately arcuate to posterior lobe, more markedly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum slightly arcuate in midregion. Lateral depressions nearly impunctate; anterior lobe slightly longer than wide, slightly larger than posterior lobe, anterior extreme arcuate; posterior lobe angulate, angle nearly right. Pronotum moderately constricted behind lateral depressions. Lateral fossulae deep, oval, length equal distance from posterior margin of fossula to margin of pronotum. Pronotal disc shiny, very slightly convex, extremely finely, extremely sparsely punctate, sparsely pubescent. Median groove moderately deep, moderately wide, slightly constricted in midregion, extremely faintly microreticulate. Anterior foveae circular, deep, moderately small, width equal distance between fovea and median groove. Posterior foveae deep, length twice width, length twice that of anterior fovea, extremely faintly microreticulate. Posterolateral angles with very shallow impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 0.92 mm; maximum width (near midlength) 0.64 mm. Disc flat, shiny, with six rows of round punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; intervals flat, width slightly less than puncture width; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal four sterna with hydrofuge pubescence. Segments 5 and 6 shiny, sparsely pubescent. Apical segment shiny; submedian setal group short. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.7:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Refer to diagnosis for comments regarding the aedeagus (Figs. 91A-F)(43 examined).

Variation. – Adults vary considerably in body size, ranging from approximately 1.20 - 1.52 mm for males, and 1.28 - 1.76 mm for females. This size variation is not correlated with geographical distribution. Samples from proximate localities exhibit extremes of size variation. For instance, some specimens from Mexico (Chiapas) are 1.21 mm (males) and 1.28 mm (females), whereas some specimens from Mexico (Mexico) are 1.52 mm (males) and 1.76 mm (females). Other representative body sizes are as follows (males/females): Arizona (1.54/1.60); Florida (1.44/1.56); Venezuela (1.28/1.36); Brazil (1.32/1.40); Argentina (1.45/1.56). Degree to which the anterior margin of the labrum is upturned in males varies considerably, from the median region upturned to form a small tooth, to entire margin upturned. Most populations exhibit the former condition; the latter condition reaches its extreme in Brazilian populations. The elytra vary slightly. Some specimens of the Florida population have the elytral apices more produced than usual. The segments of the Brazilian

population studied have the elytral punctures slightly less developed than most other populations.

Natural History. – Locality records indicate that *G. fossatus* is principally a stream form, but has a rather wide ecological tolerance. My wife Maureen and I have collected adults at the margins of tropical and desert streams in Central America. For example, we collected two specimens from a small (two feet diameter), quiet water area at the edge of a stream at the south end of Lago de Yojoa in Honduras, immediately after which a sudden rainstorm turned the stream into a raging torrent, completely submerging the microhabitat in surging, swirling water. In contrast, we found specimens in a small desert stream located on the central plateau of Mexico, 29 mi. SW Zacatecas. Specimens have also been reported from drift in Pima County, Arizona and from Lake Harney in Florida and Lake Texoma in Oklahoma. Of the 722 specimens studied, only two were taken at ultraviolet lights, and perhaps these were accidental captures. Judging from the remarkably extensive geographical distribution of *G. fossatus*, one might suspect that it is a facultative halophile, which apparently is not so.

Distribution. – (Figs. 92B,179). The range extends southward from the southern United States through Central America and the Antilles to northern South America, Brazil and Argentina. A total of 722 specimens have been examined (see appendix).

Remarks. – This species has been the object of much confusion in the literature since its description by LeConte (1855) more than a century ago. This confusion was initiated by LeConte when he described two additional species (*O. tuberculatus* and *O. foveicollis*) 23 years later for specimens which were actually conspecific with his *O. fossatus*. In the same publication, Le Conte (1878) made the error of declaring as conspecific *O. fossatus* and *O. nitidus*, a species he had described in 1850. Twelve years later, Horn (1850) added further to the confusion by making *O. tuberculatus* the junior synonym of *O. foveicollis*, even though the name *O. tuberculatus* had page priority. H. C. Fall (1919), however, detected all of these previous errors, stating that *O. nitidus* was specifically distinct from *O. fossatus*, and that *O. tuberculatus*, *O. foveicollis* and *O. fossatus* were conspecific. Considering the errors previous to Fall's publication, together with the fact that his decisions were made without the aid of male genitalic characters, it is remarkable that he was able to state the situation correctly, and is an example of the superior abilities of this fine taxonomist.

G. fossatus has the most extensive distribution of any Western Hemisphere hydraenid. Variation is exhibited, as would be expected for a species so widely distibuted. I have dissected many males from throughout the range to ensure that my concept of this species is correct. Some of these genitalia are illustrated in this work to display the variation to be expected in *G. fossatus*(Figs. 91A-F). Based upon the close similarity of these genitalic forms, I am confident that these specimens represent a single, widely distributed species. Upon study of the type-material of *O. parvulus* Sharp (1882) and *O. nitiduloides* d'Orchymont (1943), I have found these to be conspecific with *G. fossatus*, and am here placing these names in synonymy.

The genitalia of the holotype of *G. fossatus* are in a microvial attached to the pin. The following labels are also attached: (gold disc)/ Type 3065/ *O. fossatus* Lec. Col. The holotype of *O. tuberculatus* LeConte is a female labelled as follows: N.M./ Type 3130/ *O. tuberculatus* Lec./ (female sign). This specimen is clearly conspecific with *O. fossatus* and is also deposited in the LeConte collection at the M.C.Z. The syntype-series of *O. foveicollis* LeConte at the M.C.Z. consists of five specimens, all of which are conspecific with *O. fossatus*. All specimens except number four are females. In the interest of stability, I have removed and studied the male genitalia of this fourth specimen and am here designating it the lectotype of *O. foveicollis*

LeConte and have affixed a label indicating such. The genitalia are in a microvial attached to the pin. The following labels are also attached to the pin: Enterprise, Fla, May 26/ Type 4 3136/ foveicollis 4/ LECTOTYPE *Ochthebius foveicollis* LeConte by P.D. Perkins 1977. Three female specimens comprise the syntype-series of *O. parvulus* Sharp in the British Museum (Natural History). I have selected one of these as lectotype. The following labels are attached to the pin: *Ochthebius parvulus* Type D.S., Guanajuato, Mexico, Salle/ Syn-type/ B.C.A. Col. I.2. *Ochthebius parvulus*, Sharp/ Sharp Coll. 1905. - 313./ LECTOTYPE *Ochthebius parvulus* Sharp by P.D. Perkins 1977.

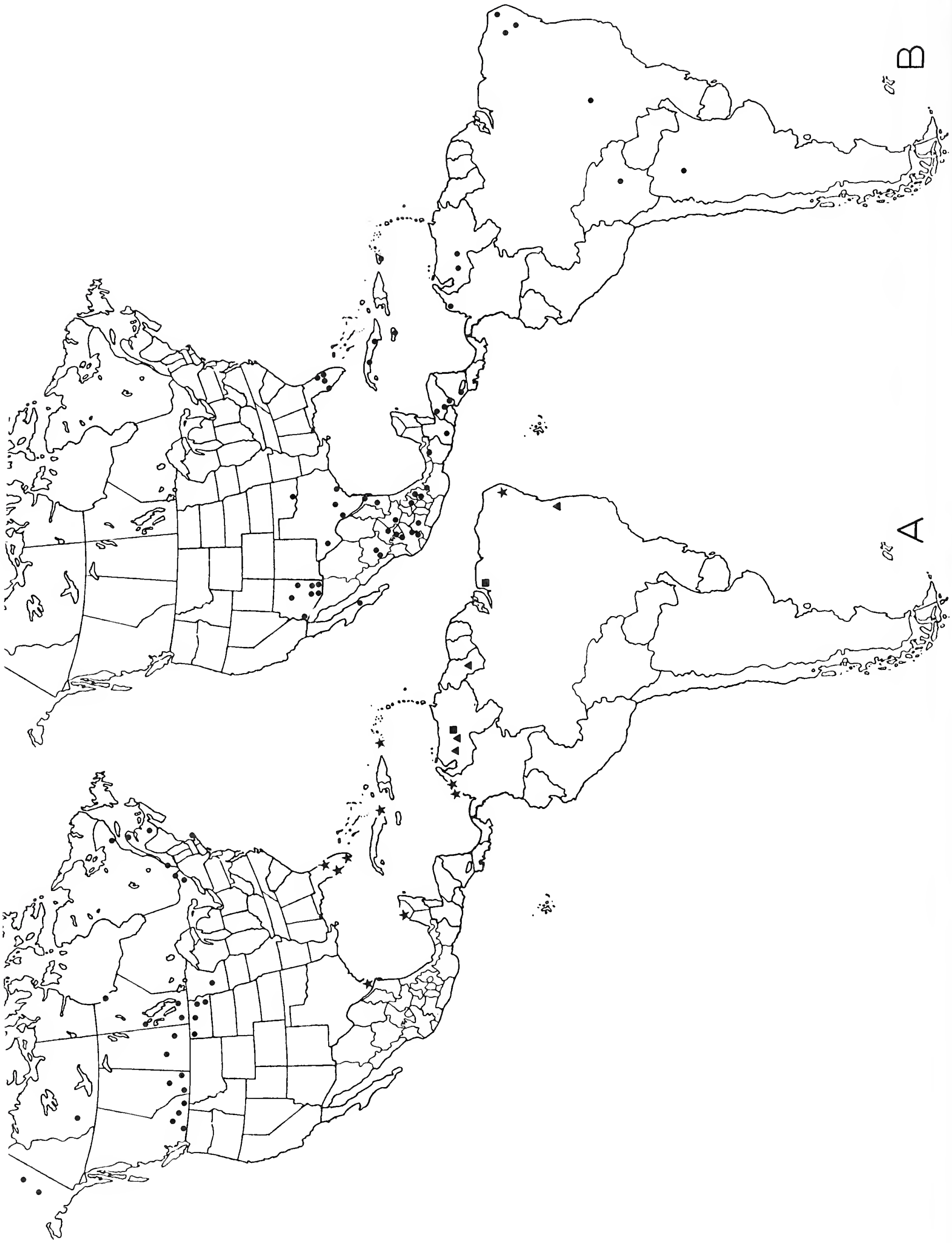
19. *Gymnochthebius falli* new species
(Figs. 89F,91G,94B,179)

Type-locality. – McAllister, Logan County, Kansas, U.S.A.

Type-specimens. – The holotype male and allotype are deposited in the USNM. These specimens, plus 35 paratypes (see appendix), were collected by Paul J. Spangler, August 29, 1956. Data about four additional paratypes are presented in the appendix.

Diagnosis. – Adults are very similar to those of *G. nitidus* and *G. fossatus*, especially the latter. Refer to the diagnosis of *G. nitidus* for a comparison to that species. *G. falli* adults have the following features which differ from those of *G. fossatus*: 1) generally larger size (males ca.1.65 mm vs. 1.45 mm long); 2) elytra light brown, contrasting with dark brown pronotum (both are dark brown in *G. fossatus*); 3) Pronotum more elongate (compare Figs. 89F,G); 4) elytra less ovate and slightly less convex; and 5) male genitalic form (compare Figs. 91G and 91A-F). The relatively restricted distribution of *G. falli* will also aid determinations where specimens from Central and South America are involved. Refer to the diagnosis of *G. fossatus* for further comment.

Description. – *Form:* Flattened, moderately elongate (Fig. 89F). *Size:* Holotype 1.64 mm long, 0.72 mm wide. *Color:* Dorsum and venter dark brown; legs and palpi brown. *Head:* Length 0.28 mm; width 0.41 mm. Frons finely sparsely punctate, very sparsely pubescent; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, finely sparsely punctate, sparsely pubescent. Labroclypeal suture straight. Labrum length 0.33 width; finely sparsely punctate, sparsely pubescent; median emargination weakly developed; entire anterior margin with upturned edge, labrum apparently evenly rounded in habitus view. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 slightly greater than 0.50 length of 3. Mentum width equal length, shining, finely densely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near anterior 0.33) 0.56 mm. Anterior hyaline border moderately wide in front of disc, wider in front of lateral fossulae. Lateral hyaline border origin near midlength anterior lobe of lateral depressions, moderately arcuate to posterior lobe, more markedly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum slightly arcuate in midregion. Lateral depressions nearly impunctate; anterior lobe longer than wide, asymmetrical, slightly larger than posterior lobe, anterior extremely arcuate; posterior lobe angulate, angle nearly right. Pronotum moderately constricted behind lateral depressions. Lateral fossulae deep, oval, length equal distance from posterior margin of fossula to margin of pronotum. Pronotal disc shiny, very slightly convex, finely, sparsely punctate, sparsely pubescent. Median groove moderately deep, narrow, slightly constricted in midregion, extremely faintly microreticulate. Anterior foveae circular, deep, moderately small, width equal distance between fovea and median groove. Posterior foveae deep, narrow, length slightly greater than twice width, length twice that of anterior fovea, extremely faintly microreticulate. Posterolateral angles with very shallow impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.02 mm; maximum width (near midlength)0.72 mm. Disc flat, shiny, with 6 rows of round punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; intervals flat, width equal puncture width; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal four sterna with hydrofuge pubescence. Segments 5 and 6 shiny, sparsely pubescent, both approximately equal in length to apical segment. Apical segment shiny; submedian setal group short. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.8:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Fig. 91G)(11 examined).



Figs. 92A – B, Geographical distributions. (A) *Ochthebius kaszabi* ●, *O. attritus* ★, *Hydraena hyalina* ▲ and *H. browni* ■. (B) *Gymnochthebius fossatus*.

Variation. – Males vary in size from 1.64 x 0.72 mm to 1.72 x 0.76 mm; females vary from 1.72 x 0.76 mm to 1.96 x 0.84 mm. Specimens from Arizona have the anterior lobe of the pronotal lateral depressions slightly longer and slightly more arcuate toward the anterior than specimens from Kansas.

Etymology. – The specific epithet is a latinized form of the surname of that remarkable amateur coleopterist, H.C. Fall.

Distribution. – (Figs. 94B,179). *G. falli* appears to be primarily a species of the southwestern United States. Four rather widely separated localities are known: southern Idaho, western Kansas, southern Arizona, and western Texas.

Remarks. – The sexes differ in shape of the labrum, which is upturned along the anterior margin in males, whereas females have the edge on the same plane as the remainder of the labrum.

The *laevipennis* Subgroup

Virtually impunctate elytra readily distinguish the rather attractive members of the *laevipennis* subgroup. Most adults are very small, quite shiny and convex, with a wide lateral hyaline border on the pronotum. Adults of some species are without one or both sets of pronotal foveae.

The four species currently known in this subgroup live in southwestern and southcentral United States, and in Central America.

20. *Gymnochthebius laevipennis* (LeConte)
(Figs. 89C,93E,G,H,94B,178)

Ochthebius laevipennis LeConte, 1878:381 (neotype female deposited in MCZ, herein designated; type-locality: Riverside, California, U.S.A.). – Horn, 1890:20. – Hatch 1965:20. – Leech and Chandler, 1956:333.

Diagnosis. – Adults of this species and those of three others are the only New World *Gymnochthebius* characterized by virtually impunctate elytra. Adults of all other known species have rows of punctures. From *G. perlabidus*, one of the three other species with impunctate elytra, *G. laevipennis* adults are differentiated by lack of posterior pronotal foveae. Adults of *G. laevipennis* differ from those of *G. maureenae* in the shiny, less convex, more elongate body and in pronotal form. These features and others that can be used to differentiate these two species are discussed under *G. maureenae* . A comparison of *G. laevipennis* to its closest relative, *G. crassipes* , is in the diagnosis section of the latter.

Description. – *Form:* Ovate, rather markedly convex (Fig. 89C). *Size:* Neotype 1.29 mm long, 0.64 mm wide. *Color:* Dorsum and venter dark brown; legs, palpi and elytral epipleura brown. *Head:* Length 0.30 mm; width 0.38 mm. Frons finely sparsely punctate, very sparsely pubescent; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, finely sparsely punctate, sparsely pubescent. Labroclypeal suture straight. Labrum length 0.33 width; finely sparsely punctate, sparsely pubescent; anterior margin shallowly emarginate. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of penultimate. Mentum width equal length, shining, finely densely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (near anterior 0.33) 0.58 mm. Anterior hyaline border narrow in front of disc, much wider in front of lateral fossulae. Lateral hyaline border very broad, origin near midlength of anterior lobe of lateral depressions, moderately arcuate to posterior lobe, more markedly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum very slightly arcuate in midregion. Lateral depressions nearly impunctate; anterior lobe slightly longer than wide, slightly larger than posterior lobe, anterior extreme arcuate; posterior lobe angulate, angle nearly right. Pronotum moderately constricted behind lateral depressions.

Lateral fossulae deep, round, diameter equal to 0.33 distance from posterior margin of fossula to margin of pronotum. Pronotal disc shiny, very slightly convex, extremely finely, extremely sparsely punctate, sparsely pubescent. Median groove narrow, shallow. Anterior foveae circular, shallow, small, width equal to 0.50 distance between fovea and median groove. Posterior foveae absent. Posterolateral angles lacking impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 0.82 mm; maximum width (near midlength)0.64 mm. Disc convex, very shiny, nearly impunctate, with six rows of extremely short and fine setae between suture and humeri. Sides convex. Elytra gradually sloping to rear, without marked point of declivity. Explanate margin rather strongly developed. *Abdomen:* Basal four sterna with hydrofuge pubescence. Segments 5 and 6 shiny, sparsely pubescent. Apical segment shiny; submedian setal group short. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.7:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Refer to the diagnosis of *G. fossatus* for comments on structure of the aedeagus (Figs. 93E,G)(4 examined); female (Fig. 93H)(1 examined).

Variation. – Males have the anteromedial margin of the labrum upturned in form of a dentiform process; females do not have this process. No other notable variation was seen in the 24 specimens studied. (see appendix)

Distribution. – (Figs. 94B,178) *G. laevipennis* is distributed from southern Oregon south through the coastal mountain ranges of California to Baja California.

Remarks. – Despite a thorough search of the LeConte *Ochthebius* types at the Museum of Comparative Zoology, I was unable to find any specimens of *O. laevipennis* LeConte. The H.C. Fall collection at that institution, however, had two female specimens of *O. laevipennis*, one of which I designated as neotype. It is with the other LeConte *Ochthebius* types at the MCZ labelled as follows: Riverside Cal., F.E. Winters/ H.C. Fall Collection/ NEOTYPE *Ochthebius laevipennis* LeC. by P.D. Perkins 1977. According to the original description (LeConte, 1878), the missing holotype was collected at Tejon, California. Although a major portion of the range of this species has been rather extensively collected, only 24 specimens were seen during this study. Whether this indicates an unusual, as yet unsampled biotope, or small population size remains to be determined. I suspect the latter.

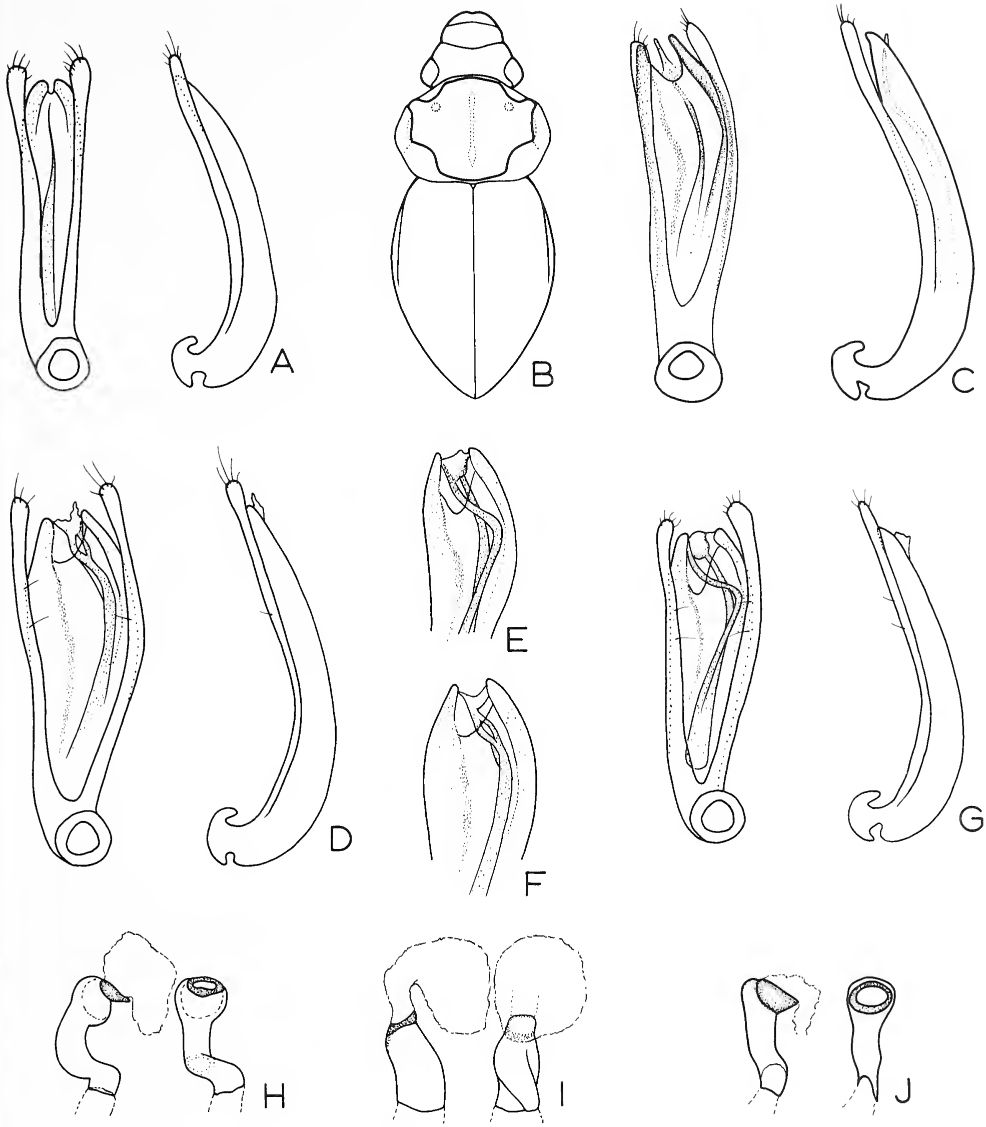
21. *Gymnochthebius crassipes* (Sharp)
(Figs. 93B,C,178)

Ochthebius crassipes Sharp, 1882:90. (lectotype male in BMNH, here designated; type-locality: Duenas, Guatemala).

Diagnosis. – Shape of the pronotum is quite different from that of *G. laevipennis* , its closest relative. In *G. crassipes* the anterior lobes of the lateral depressions are short and distinctively deflexed, whereas those of *G. laevipennis* are longer (Figs. 89C,93B) and not deflexed. Stated differently, the angle that forms the anterior and posterior lobes of each lateral depression is at the anterior 0.33 in *G. crassipes* whereas it is at midlength in *G. laevipennis* . In addition, *G. crassipes* lacks anterior foveae, this region being transversely, shallowly depressed. The anterior foveae of *G. laevipennis* are well demarcated.

Other, less obvious differences include shape of the male labrum which is shallowly emarginate and with the edge of the emargination upturned to from a dentiform process in *G. laevipennis* . The labrum of *G. crassipes* (males) is more broadly emarginate and has the entire anterior border upturned. The legs of *G. crassipes* are longer, and mesotarsomere 5 is angulate at its base and quite thickened, hence Sharp's specific epithet.

Description. – *Form:* Very convex, moderately ovate (Fig. 93B). *Size:* Lectotype is 1.56 mm long, 0.68 mm wide. *Color:* Dorsum dark brown; venter brown. *Head:* Length 0.32 mm; width 0.42 mm. Frons extremely finely punctate; interocular foveae deep and large, width of each 0.50 distance separating them; interocular tuberculi moderately large; basomedial fovea transverse. Frontoclypeal suture angulate. Clypeus length 0.50 width; very finely sparsely punctate. Labroclypeal suture straight. Labrum length 0.33 width; finely microreticulate; anterior border emarginate, edge upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, finely punctate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena depressed,



Figs. 93A – J, *Gymnochthebius*. (A) *G. oppositus*, holotype aedeagus. (B) *G. crassipes*, body outline. (C) *G. crassipes*, lectotype aedeagus. (D) *G. nitidus* aedeagus, Illinois. (E) *G. laevipennis* aedeagus, Baja California, Mexico. (F) *G. nitidus* aedeagus, Blaine County, Montana. (G) *G. laevipennis* aedeagus, Riverside County, California. (H) *G. laevipennis*, spermatheca. (I) *G. perlabidus*, spermatheca. (J) *G. maureenae*, spermatheca.

finely punctulate. *Thorax:* Pronotum length at midline 0.46 mm. maximum width (near anterior 0.33) 0.66 mm. Anterior hyaline border narrow in front of disc, much wider in front of lateral fossulae. Lateral hyaline border very broad, origin at apex of anterior lobe of lateral depressions, strongly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum weakly arcuate to front in midregion, markedly arcuate to rear laterally. Lateral depressions very shiny, virtually impunctate; anterior lobes distinctively deflexed, width equal length, much smaller than posterior lobes; posterior lobes in form of parallel sides, each posterior lobe angulate, angle nearly right. Pronotum rather markedly constricted behind lateral depressions. Lateral fossulae circular, small, deep, diameter equal to 0.20 distance from posterior margin of fossula to margin of pronotum, measured longitudinally. Pronotal disc very convex and very shiny, extremely finely sparsely punctate. Median groove narrow, well defined. Anterior foveae absent, this area with shallow transverse depression. Posterior foveae absent. Posterolateral angles without impressions. *Elytra:* Length 0.94 mm. maximum width (near anterior 0.33) 0.68 mm. Disc very shiny and very convex, nearly impunctate. Elytra gradually sloped to rear, without marked point of declivity. Explanate margin rather markedly developed in anterior 0.50, absent from posterior 0.50. *Abdomen:* Basal four sterna with hydrofuge pubescence. Segments 5 and 6 shiny, sparsely pubescent. Apical segment shiny and with a small rounded elevation in midline; sparsely and randomly pubescent at sides, without discrete rows of setae. *Legs:* Moderately long and somewhat stout; ratio of hind leg length to abdominal length 2.4:1.0. Mesotarsomere 5 angulate near base and distinctly thickened. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Fig. 93C)(1 examined).

Distribution. – (Fig. 178) Known only from the type-locality in Guatemala.

Remarks. – As Sharp (1882) stated in the original description, *G. crassipes* is truly a "remarkable" species. The highly polished and very convex dorsal surface together with the smooth contours of the pronotum and the very wide hyaline borders results in an elegant appearance, like that of fine jewelry.

The thickened mesotarsus is quite certainly a modification to aid copulation, an aid necessitated by the polished and convex dorsum. Sharp (1882) suggested that it was "probable, from its strong middle legs, that it adheres to rocks in rapid water, as do the *Henicoceri*". The convex shape of the body suggests, however, that this is not so. Indeed, even the postgena is deeply indented to allow the head to be markedly deflexed, resulting in an even greater body convexity. Perhaps members of this species prefer locations relatively high on stream banks where interstitial space is adequate, as I (1976) have demonstrated for the convex *O. (Asiobates) puncticollis*.

22. *Gymnochthebius perlabidus* new species
(Figs. 89B,93I,178)

Type-locality. – Hamburg Farm, Reventazon, Prov. Limon, Costa Rica.

Type-specimens. – The holotype female and one female paratype with same data are deposited in USNM. These specimens were collected by F. Nevermann in 1933.

Diagnosis. – The two females are so distinctive that I have no reservations about describing them even though males are not yet known. The three other Western Hemisphere *Gymnochthebius* whose adults also possess virtually impunctate elytra, *G. laevipennis* , *G. crassipes* , and *G. maureenae*, are without posterior pronotal foveae. These foveae are well developed in *G. perlabidus* females. In addition, the spermatheca of these specimens is different from the spermatheca of *G. laevipennis* females (Figs. 93H-I).

Description. – *Form:* Ovate, moderately convex (Fig. 89B). *Size:* Holotype 1.28 mm long, 0.64 mm wide. *Color:* Brown. *Head:* Length 0.26 mm. width 0.38 mm. Frons extremely finely sparsely punctate, very sparsely pubescent; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, finely sparsely punctate, sparsely pubescent. Labroclypeal suture straight. Labrum length 0.33 width; finely sparsely punctate, sparsely pubescent, weakly emarginate. Maxillary palpomere 3 moderately wide; palpomere 4 0.66 length of 3. Mentum width equal length, shining, finely densely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.34 mm; maximum width (near anterior 0.33) 0.56 mm. Anterior hyaline border narrow in front of disc, wider in front of lateral fossulae. Lateral hyaline

border origin near apex of anterior lobe of lateral depressions, arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum slightly arcuate in midregion. Lateral depressions nearly impunctate; anterior lobe width equal length, much larger than posterior lobe, anterior extreme arcuate; posterior lobe angulate, angle nearly right. Pronotum markedly constricted behind lateral depressions. Lateral fossulae large, very deep, oval, length equal distance from posterior margin of fossula to margin of pronotum. Pronotal disc shiny, convex, extremely finely, extremely sparsely punctate, sparsely pubescent. Median groove narrow, shallow, extremely faintly microreticulate. Anterior foveae circular, deep, moderately small, width equal to 0.50 distance between fovea and median groove. Posterior foveae moderately deep, length twice width, length twice that of anterior foveae. Posterolateral angles without impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 0.84 mm; maximum width (near midlength)0.64 mm. Disc convex, impunctate, extremely finely, extremely sparsely pubescent. Sides convex. Elytra gradually sloped to rear, without marked point of declivity. Explanate margin rather markedly developed. *Abdomen:* Basal four sterna with hydrofuge pubescent. Segments 5 and 6 shiny, sparsely pubescence. Apical segment setose. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.8:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Female (Fig. 93I)(2 examined); male unknown.

Variation. – No notable variation was seen in the two available specimens.

Distribution. – (Fig. 178) Known only from the type-locality in Costa Rica.

Etymology. – From the Latin *per* (very) and *labidus* (slippery). I refer to the very smooth dorsal surface and aquatic habits of this species.

Remarks. – The specimens were collected from a "puddle".

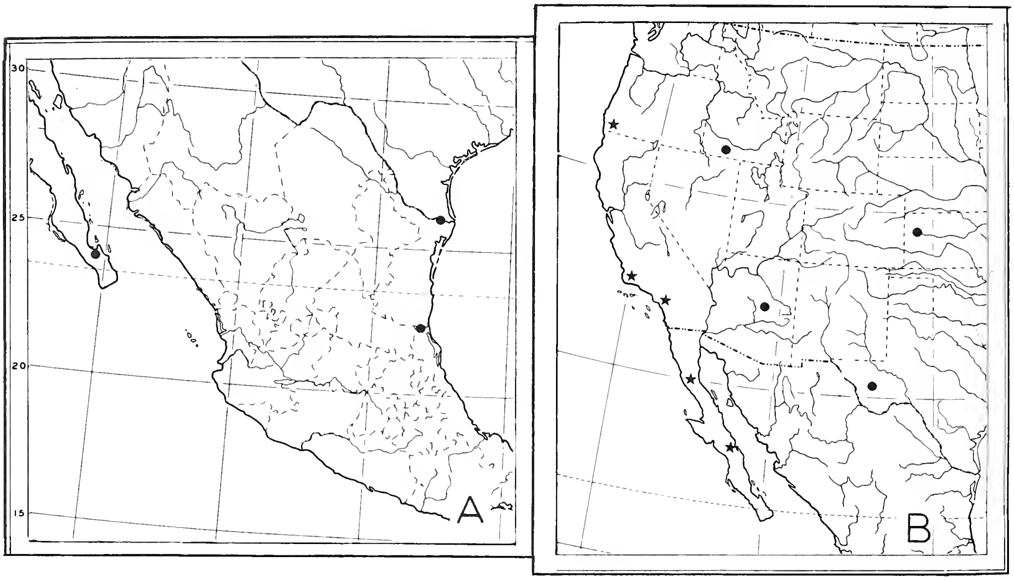
23. *Gymnochthebius maureenae* new species
(Figs. 89A,93J,178)

Type-locality. – Lucedale, George County, Mississippi, U.S.A.

Type-specimens. – The holotype female is deposited in USNM. Female paratypes are deposited in USNM (1) and PDP (2). All specimens were collected by H. Dietrich in 1930.

Diagnosis. – The differences between adults of this species and those of the three other species which also lack rows of elytral punctures are so distinctive that I have no reservations concerning its validity even though males are not yet available. *G. maureenae* adults are similar to those of *G. laevipennis* in that both lack posterior pronotal foveae, in contrast to adults *G. perlabidus* which have these depressions. However, *G. maureenae* adults differ from *G. laevipennis* adults in a number of respects, the most obvious being dull dorsal surface and more robust body form. *G. laevipennis* adults are extremely shiny, less convex and more elongate. Additionally, the following features differ in the two species: 1) form of anterior pronotal margin (evenly arcuate in *G. maureenae*; *G. laevipennis* with pronounced excavations in front of lateral fossulae) (Figs. 89A,C); 2) pubescence of lateral areas of pronotum (dense in *G. maureenae*, very sparse in *G. laevipennis*); 3) size of lateral fossulae (much larger than anterior foveae in *G. maureenae*, equal in size, or slightly smaller than anterior foveae in *G. laevipennis*); 4) elytral sculpture near apex (very shallow grooves in *G. maureenae* , smooth in *G. laevipennis*).

Description. – *Form:* Broadly ovate, very convex (Fig. 89A). *Size:* Holotype 1.20 mm long, 0.64 mm wide. *Color:* Dorsum and venter dark brown; legs and palpi brown. *Head:* Length 0.26 mm; width 0.40 mm. Frons dull, finely sparsely punctate, finely microreticulate, very sparsely pubescent; interocular foveae deep and large, width of each 0.50 distance between them; interocular tuberculi large; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus dull, length 0.50 width, finely microreticulate, sparsely pubescent. Labroclypeal suture straight. Labrum length nearly 0.33 width; finely microreticulate, feebly emarginate. Maxillary palpus very short, palpomere 3 wide; palpomere 4 0.33 length of 3. Mentum width equal length, finely microreticulate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (near anterior 0.33) 0.62 mm. Anterior hyaline border narrow in front of disc, slightly wider in front of lateral fossulae. Lateral hyaline border very wide, origin at apex of anterior lobe of lateral depressions, markedly arcuate to base, very narrow around posterior margin. Anterior margin of pronotum slightly arcuate, without emarginations in front of lateral



Figs. 94A – B, Geographical distributions of *Gymnochthebius* species. (A) *G. oppositus*. (B) *G. falli* ● and *G. laevipennis* ★.

depressions. Lateral depressions dull, nearly impunctate, very finely microreticulate; anterior lobe longer than wide much larger than posterior lobe, anterior extreme arcuate; posterior lobe angulate, angle nearly right, posterior side of lobe very hairy. Pronotum markedly constricted behind lateral depressions. Lateral fossulae large, deep, oval; anterior margin ended abruptly, posterior area gradually elevated to level of surrounding surface. Pronotal disc dull, finely microreticulate. Median groove narrow, shallow. Anterior foveae circular, deep, moderately large, width equal distance between fovea and median groove. Posterior foveae absent. Posterolateral angles without impressions. Prosternum with low median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 0.80 mm; maximum width (near midlength) 0.64 mm. Disc very convex, dull, finely microreticulate, without discrete rows of punctures; with rows of very short setae. Declivity origin near midlength. Explanate margin well developed. *Abdomen:* Basal four sterna with hydrofuge pubescence. Segments 5 and 6 shiny, sparsely pubescent. Apical segment shiny; setae randomly placed, not in discrete rows. *Legs:* Moderately short and very stout; ratio of hind leg length to abdominal length 2.0:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Female (Fig. 93J)(1 examined); male unknown.

Variation. – Too few specimens are available to adequately assess variation.

Distribution. – (Fig. 178) Known only from the type-locality in George County, Mississippi, U.S.A.

Etymology. – I am pleased to dedicate this species to my wife Maureen, who has been a constant source of encouragement and aid during the course of this study.

The *oppositus* Subgroup

This distinctive subgroup contains species whose adults are very small, and have the posterior lobes of the lateral depressions larger than the anterior lobes, a condition opposite that seen in the remainder of the genus. The elytra are costate or subcostate and the dorsal pubescence is well developed, especially on the pronotum.

The two species presently known, one each from Mexico and Florida, are apparently adapted to brackish water habitats.

24. *Gymnochthebius oppositus* new species
(Figs. 9I,89E,93A,94A)

Type-locality. – Two miles north of La Paz, Baja California, Mexico.

Type-specimens. – The holotype male is deposited in CAS. This specimen and one male paratype (PDP) with identical locality data were collected by Hugh B. Leech, December 29, 1958. The allotype is deposited in USNM, and has the following data: Mexico, Veracruz, 8 mi. NE Panuco, 28-VIII-1965, P.J. Spangler. One additional paratype male is deposited in MCZ: Texas, Cameron County, Brownsville, 16-VI-1933, Darlington.

Diagnosis. – Within *Gymnochthebius*, only *G. oppositus* and *G. seminole* adults have the posterior lobe of the pronotal lateral depressions larger than the anterior lobe. From *G. seminole* , *G. oppositus* adults are distinguished by the adpressed versus decumbent setae on the elytral intervals, among other features. Refer to the diagnosis of *G. seminole* for further comparisons.

Description. – *Form:* Truncate, somewhat flattened (Fig. 89E). *Size:* Holotype 1.32 mm long, 0.62 mm wide. *Color:* Dorsum and venter dark brown; legs and palpi brown. *Head:* Length 0.26 mm; width 0.36 mm. Frons finely sparsely punctate, sparsely pubescent; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi small; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, finely sparsely punctate, prominently pubescent. Labroclypeal suture straight. Labrum length 0.33 width; finely sparsely punctate, sparsely pubescent; median emargination slightly developed, with upturned edge in form of very small tooth in habitus view. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 slightly greater than 0.50 length of 3. Mentum width equal length, shining, moderately densely punctate; anterior margin arcuate. Submentum evenly, finely

punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.34 mm; maximum width (near anterior 0.33) 0.50 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of anterior foveae, then tapered to anterior angles. Lateral hyaline border origin near midlength of anterior lobe of lateral depressions, moderately arcuate to posterior lobe, more markedly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum slightly arcuate in midregion. Lateral depressions prominently pubescent along margins, nearly impunctate; anterior lobe angulate, anterior extreme acute, slightly smaller than posterior lobe. Posterior lobe rectangular, posterior angle in form of small tooth. Pronotum markedly constricted behind lateral depressions. Lateral fossulae deep, with prominent setae at posterior extreme. Pronotal disc shiny, convex, impunctate, with long, moderately sparse hairs at margins of foveae. Median groove deep, moderately wide, slightly constricted in midregion, extremely faintly microreticulate. Anterior foveae large, deep, width twice distance between fovea and median groove. Posterior foveae deep, arcuate, length three times width, length twice that of anterior fovea. Posterolateral angles lacking impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum median glabrous area large, with vertical lateral margins. *Elytra:* Length 0.80 mm; maximum width (near midlength) 0.62 mm. Disc flat, shiny, with six rows of round punctures between suture and humeri, punctures apparently without setae. Sides convex, declivity origin near posterior 0.33. Intervals slightly elevated, width equal puncture width, each interval with a row of adpressed setae. Interstices between punctures 0.25-0.50 puncture length. Explanate margin moderately developed, with a narrow fringe of short setae in anterior 0.25. *Abdomen:* Basal four sterna with hydrofuge pubescence. Segments 5 and 6 shiny, sparsely pubescent. Apical segment shiny; submedian setal group short. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.7:1.0. Posterior tibiae widest near midlength. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Fig. 93A)(3 examined); female (Fig. 91)(1 examined).

Variation. – The Brownsville, Texas specimen has the apex of the posterior lobes of the lateral depressions slightly bifid, whereas those of the Baja California specimens are not.

Natural History. – This unusual species is presently represented by only four individuals from three widely separated localities. Two specimens are from La Paz, Baja California (approximately 24 degrees north latitude). Another specimen is from Brownsville, Texas (approximately 26 degrees north latitude). The fourth specimen is from Panuco, Veracruz, Mexico (22 degrees north latitude). Remarkably, no specimens have been collected in the area between the eastern and western sites, which includes the greatest width of Mexico. This disjunct distribution is probably a result of lack of adequate sampling in appropriate habitats.

The specimens collected by Hugh B. Leech in La Paz bear the label notation: "in brackish (tidal) pool". The only known specimen of the closely related *G. seminole* , collected by W.R. Suter, was taken from the Everglades, Florida in a "sawgrass-mangrove area". Further collecting in these habitats, which are unusual (but not unique) for Western Hemisphere hydraenids, will undoubtedly reveal additional specimens, and perhaps additional species.

Distribution. – (Fig. 94A) Known from three disjunct localities: La Paz, Baja California, Mexico; Veracruz, Mexico; and Brownsville, Texas.

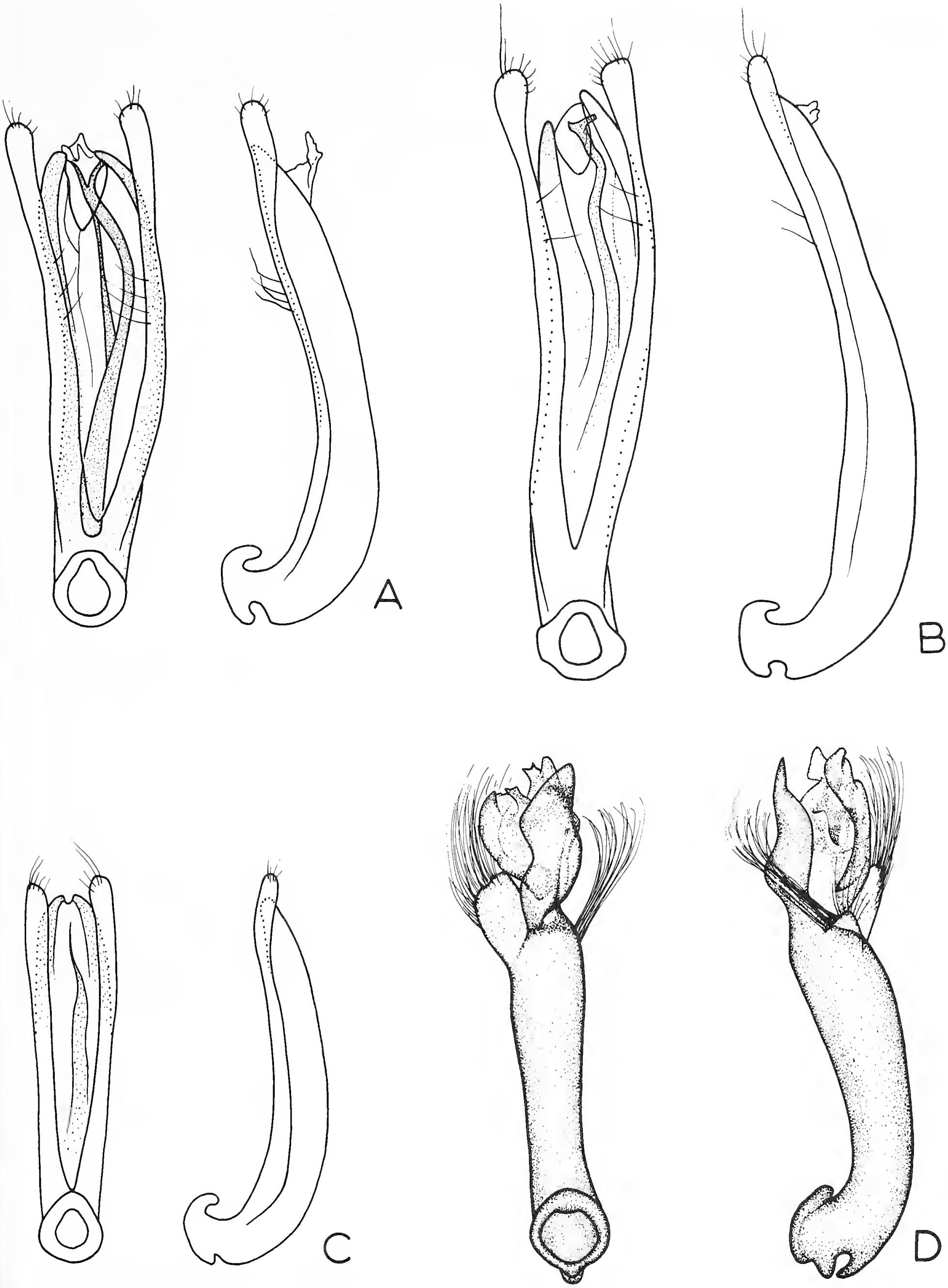
Etymology. – Latin *oppositus* (on the other side, contrary). This is in reference to the shape of the pronotum which, with the posterior lobes larger than the anterior lobes, is opposite the condition seen in all known *Gymnochthebius* species but one, *G. seminole.* The "O's" in the name are suggestive of the oval shape of these beetles.

25. *Gymnochthebius seminole* new species
(Figs. 89D,95C)

Type-locality. – Five miles North of Flamingo, Everglades National Park, Monroe County, Florida, U.S.A.

Type-specimen. – The holotype male (unique) is deposited in USNM. The specimen was collected by W. Suter in 1965.

Diagnosis. – This distinctive species, presently known from a single male specimen collected in the Florida Everglades, is readily recognized by virtue of a set of unusual characteristics. The



Figs. 95A – D, Aedeagi of holotypes. (A) *Gymnochthebius bartyrae*. (B) *G. bisagittatus*. (C) *G. seminole*. (D) *Hydraena paeminosa*.

short (1.20 mm), robust body form and costate elytra together with the fact that the lateral depressions of the pronotum have the posterior lobe larger than the anterior lobe make this species different from all other *Gymnochthebius* species except one, *oppositus*. From *G. oppositus* , *G. seminole* is distinguished by its geographical distribution and condition of elytral setae. These setae are decumbent on the elytral intervals and for the entire length along the elytral margin in *G. seminole* . However, in *G. oppositus* the setae are adpressed on the intervals and less apparent on the margin. The amount of pubescence extending laterally from the sclerotized part of the pronotum reaches its greatest expression, among New World *Gymnochthebius*, in these two species.

Description. – *Form:* Truncate, robust (Fig. 89D). *Size:* Holotype 1.20 mm long, 0.64 mm wide. *Color:* Dorsum and venter black; legs and palpi dark brown. *Head:* Length 0.26 mm; width 0.36 mm. Frons finely sparsely punctate, prominently pubescent; interocular foveae deep and large, width of each equal distance separating them; interocular tuberculi small; basomedial fovea transverse. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, finely sparsely punctate, prominently pubescent. Labroclypeal suture straight. Labrum length 0.33 width; finely sparsely punctate, sparsely pubescent; median emargination absent. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 slightly greater than 0.50 length of 3. Mentum width equal length, shining, densely, deeply punctate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.32 mm; maximum width (near anterior 0.33) 0.56 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near midlength of anterior lobe of lateral depressions, moderately arcuate to posterior lobe, more markedly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum slightly arcuate in midregion. Lateral depressions very prominently pubescent at sides, nearly impunctate; anterior lobe angulate, anterior extreme acute, slightly smaller than posterior lobe; posterior lobe rectangular, posterior angle forming a small tooth. Pronotum markedly constricted behind lateral depressions. Lateral fossulae deep, prominently pubescent at posterior extreme, otherwise non-pubescent. Pronotal disc prominently pubescent, shiny, convex, extremely finely, extremely sparsely punctate. Median groove deep, moderately wide, slightly constricted in midregion, extremely faintly microreticulate. Anterior foveae cirrcular, very deep, moderately large, width slightly greater than distance between fovea and median groove. Posterior foveae deep, length three times width, length twice that of anterior fovea. Posterolateral angles without impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternal median glabrous area large, with vertical lateral margins. *Elytra:* Length 0.78 mm; maximum width (near midlength) 0.64 mm. Disc very convex, moderately shiny, with six rows of round punctures between suture and humeri, punctures apparently lacking setae. Sides convex, declivity origin near posterior 0.33. Intervals slightly elevated, width 0.50 puncture width, each interval with a row of short, decumbent setae. Interstices between punctures 0.25 puncture length. Explanate margin moderately developed, with dense fringe of short, decumbent setae, from anterior angles to apices. *Abdomen:* Basal four sterna with hydrofuge pubescence. Segments 5 and 6 shiny, sparsely pubescent. Apical segment shiny; submedian setal group short. *Legs:* Moderately short and stout; ratio of hind leg length to abdominal length 1.6:1.0. Posterior tibiae widest near midlength. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Fig. 95C)(1 examined); female unknown.

Natural History. – The specimen was collected in "Snake Bight trail, sawgrass-mangrove area", August 27, 1965. For a discussion of the habitats of *G. seminole* and *G. oppositus* , refer to the "Natural History" section of the latter.

Distribution. – Known only from the type-locality in Florida.

Etymology. – *seminole* is a noun in apposition referring to the Seminole Indians of the Florida Everglades.

GENUS *OCHTHEBIUS* LEACH

Ochthebius Leach, 1815:95 (type-species: *Elophorus marinus* Paykull, 1798:245). – LeConte, 1878:378. – Kuwert, 1887:369. – Horn, 1890:17. – Knisch, 1924. – d'Orchymont, 1932, 1933, 1940, 1941a, 1941b, 1942a, 1942b, 1942c, 1943a, 1943b. – Leech and Chandler, 1956. – F.Balfour-Browne, 1958.

Discussion. – The genus *Ochthebius* is a diverse and widespread group, species being found on all continents and many islands. It is not yet reported from New Zealand (Wise, 1973) and the subantarctic islands, where, however, the related genus *Meropathus* is found (Ordish, 1971).

In the Western Hemisphere the majority of *Ochthebius* species are in western United States and Mexico, but the genus is represented in all areas of North America except northernmost Canada and a large portion of southeastern United States (Fig. 161).

Other than two species of *Ochthebius* in northernmost South America, *O. lineatus* and *O. attritus* (Figs. 92A,107), plus an undescribed species in the *biincisus* Group from Colombia (I have seen only a single female), the genus is replaced in South America by *Gymnochthebius* (Fig. 161).

Gymnochthebius was formerly treated as a subgenus of *Ochthebius* (d'Orchymont, 1943b), but is herein accorded equal rank based upon morphologic and zoogeographic considerations (refer to the section on *Gymnochthebius* for a discussion of these topics).

A detailed analysis of *Ochthebius* and *Gymnochthebius* distribution is presented in the section on zoogeography.

The European components of the genus have received much more attention than those in the Western Hemisphere, principally by Armand d'Orchymont in the 1930's and 1940's. Much of d'Orchymont's work included clarifying the numerous subgenera erected by Kuwert (1887). Although d'Orchymont (1941a, 1941b, 1942a, 1942b) recognized some previously described subgenera and described additional subgenera (1933, 1943), other workers have more-or-less ignored the subgeneric categories.

Horn (1890), in his review of the 13 species of *Ochthebius* then known from North America, refers thusly to Kuwert's subgenera: "In a study of our species in a comparison with those of Europe it is possible, by allowing a little latitude to the subgenera, to admit certain of our species, while a number might warrant the formation of other subdivisions, but it seems to me unnecessary to burden our nomenclature with names for generic groups which have not full generic value."

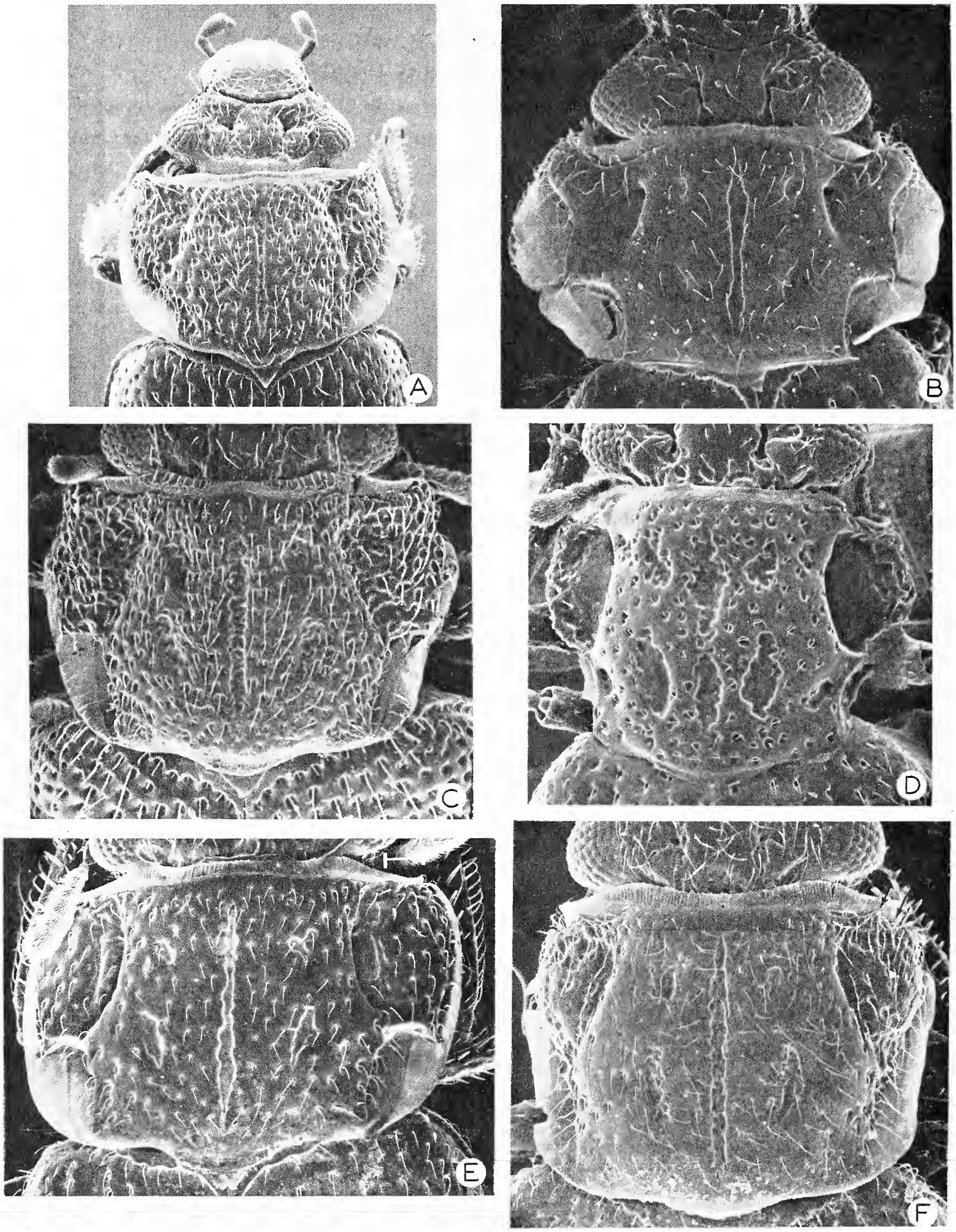
Likewise, F.Balfour-Browne (1958) in his review of the British species, expressed his dislike for subgenera within *Ochthebius*: "Unfortunately, these groups have been described as subgenera although in at least some of them there is no justification for regarding them as natural groups."

More recently, Janssens (1969) has described a new species (*O. elegans*) which forms the transitional stage between Kuwert's *Doryochthebius* and Wollaston's *Calobius* subgenera, and has therefore placed *Doryochthebius* into synonomy. It is apparent that as more and more species are discovered and described, the distinctions between at least some of the subgenera of *Ochthebius* become less and less.

It is not my intent to present a complete worldwide review of the subgroups of *Ochthebius* and their relative rankings. Rather, I wish to point out that the Western Hemisphere components of *Ochthebius* (not including *Meropathus*, *Gymnochthebius* and *Neochthebius*) appear to form two major groups, one being *Ochthebius (sensu stricto)* Leach and the other *O. (Asiobates)* Stephens.

Ochthebius cribricollis LeConte of Canada and the United States (Fig. 136D) has consistently been placed in *O. (Homalochthebius)* Kuwert (Horn, 1890; Knish, 1924; d'Orchymont, 1942a; Hatch, 1965). This subgenus is characterized by combination of deeply excavate posterior angles of the pronotum and absence of pronotal foveae. The only difference, therefore, between *Homalochthebius* and *Asiobates* is lack of pronotal foveae in adults of the former taxon.

Body shape of *O. similis* adults (Fig. 136B) is very suggestive of *O. cribricollis* (Fig. 136D) adults, but the former have well developed posterior pronotal foveae. Indeed, aedeagi of males



Figs. 96A – F, Pronota of Ochthebiinae. (A) *Ochthebius rectus*. (B) *Gymnochthebius nitidus*. (C) *O. angularidus*. (D) *O. benefossus*. (E) *O. discretus*. (F) *O. aztecus* (arrows indicate postocular emargination and process).

of the two species (Figs. 138B-D) indicate a close relationship. Another transitional stage is seen in *O. brevipennis*, whose adults are closely similar externally to those of *O. cribricollis*, (Fig. 136F). However, the former are without a transverse depression at the posterior extreme of the median groove which could be considered the first stage in loss (or formation) of foveae.

These two species might not form the phylogenetic nexus between *Homalochthebius* and *Asiobates per se*, but the characters upon which *Homalochthebius* is based are probably of a transitory and reversible nature.

In fact, if one compares illustrations of aedeagi of males of the species placed in *Homalochthebius* by d'Orchymont (1942a), without exception the parameres diverge from the main-piece. Likewise, parameres of *Asiobates* (Figs. 141A-D,144A-E) males constantly diverge from the main-piece in the same manner (see illustrations in d'Orchymont, 1940, 1941b for Palearctic *Asiobates*).

By contrast, however, the parameres of male *Ochthebius (sensu stricto)* (Figs. 100A-D,114A-E) are invariably along the main-piece. Judging from the illustrations provided by d'Orchymont, this type of aedeagus is found in *Ochthebius (sensu stricto)* (1943), *O. (Hymenodes)* Mulsant (1942b, 1942c), and *O. (Henicocerus)* (1941a).

It appears that the two aedeagal groups mentioned above are constant and the monophyly of each inferred from aedeagal structure is supported by external characteristics, as similarity of illustrations of body outline provided herein reveals.

Ochthebius benefossus LeConte was placed in *O. (Henicocerus)* by Knisch (1924). This species is obviously not closely related to any other Western Hemisphere *Ochthebuis*, as its body outline, pronotum, and aedeagal apex testify (Figs. 96D,131A,132B). Further, it is the only species of *Ochthebius* in the Appalachian Mountains. However, it is obviously more closely related to *Ochthebius (sensu stricto)* than to *O. (Asiobates)*, including the relationship between the parameres and the main-piece. Consequently, I have included *O. benefossus* in *Ochthebius (sensu stricto)*.

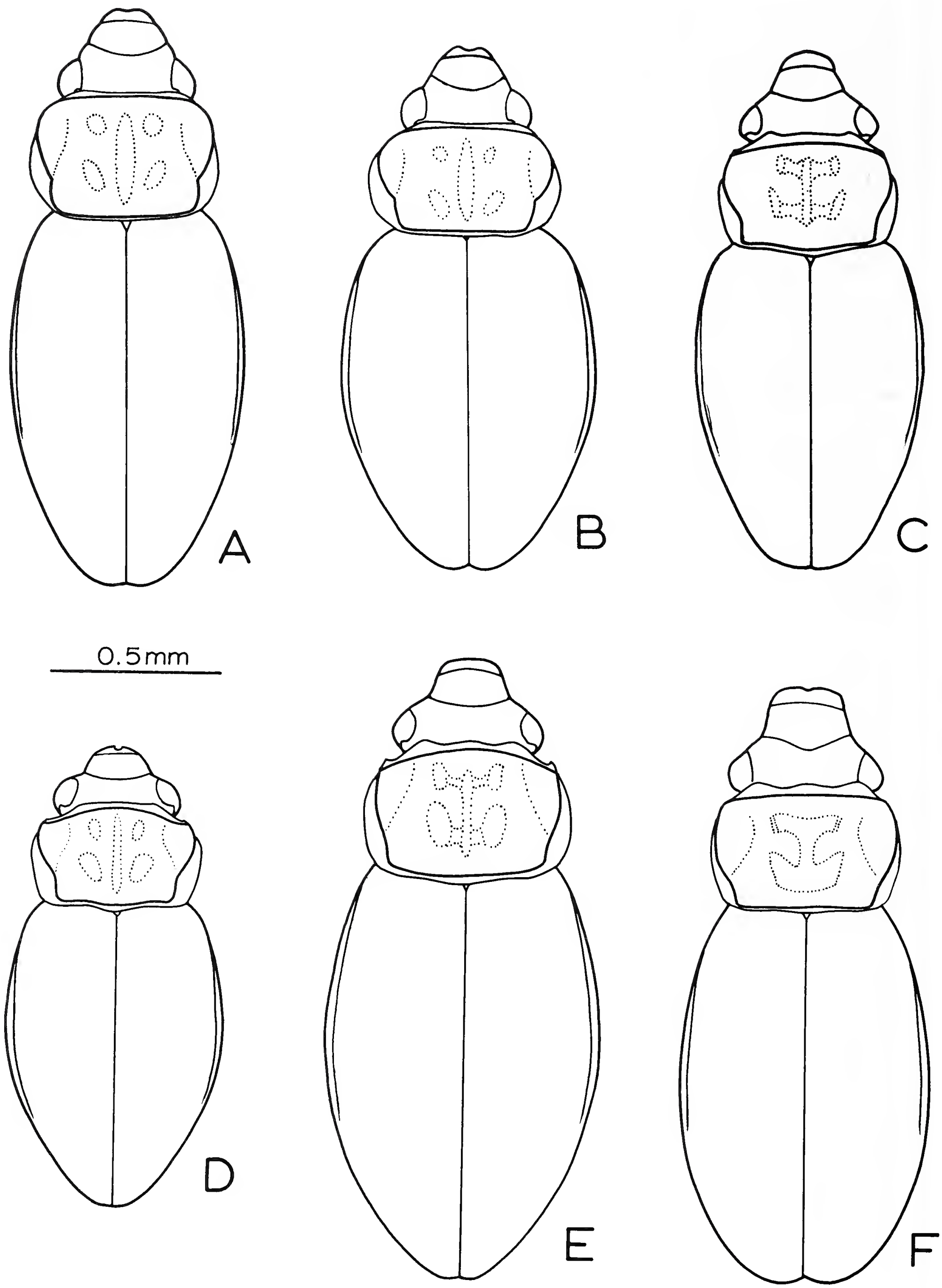
Most early descriptions of North American *Ochthebius* were made by J.L. LeConte, beginning with *O. cribricollis* and *O. nitidus* in 1850 and continuing to 1878. In all, LeConte described 13 species of North American *Ochthebius*.

Horn (1890) provided the only comprehensive treatment of the genus, his study including the 13 species then recognized as valid for North America, but omitting those described by Sharp (1882, 1887) from Mexico and Guatemala.

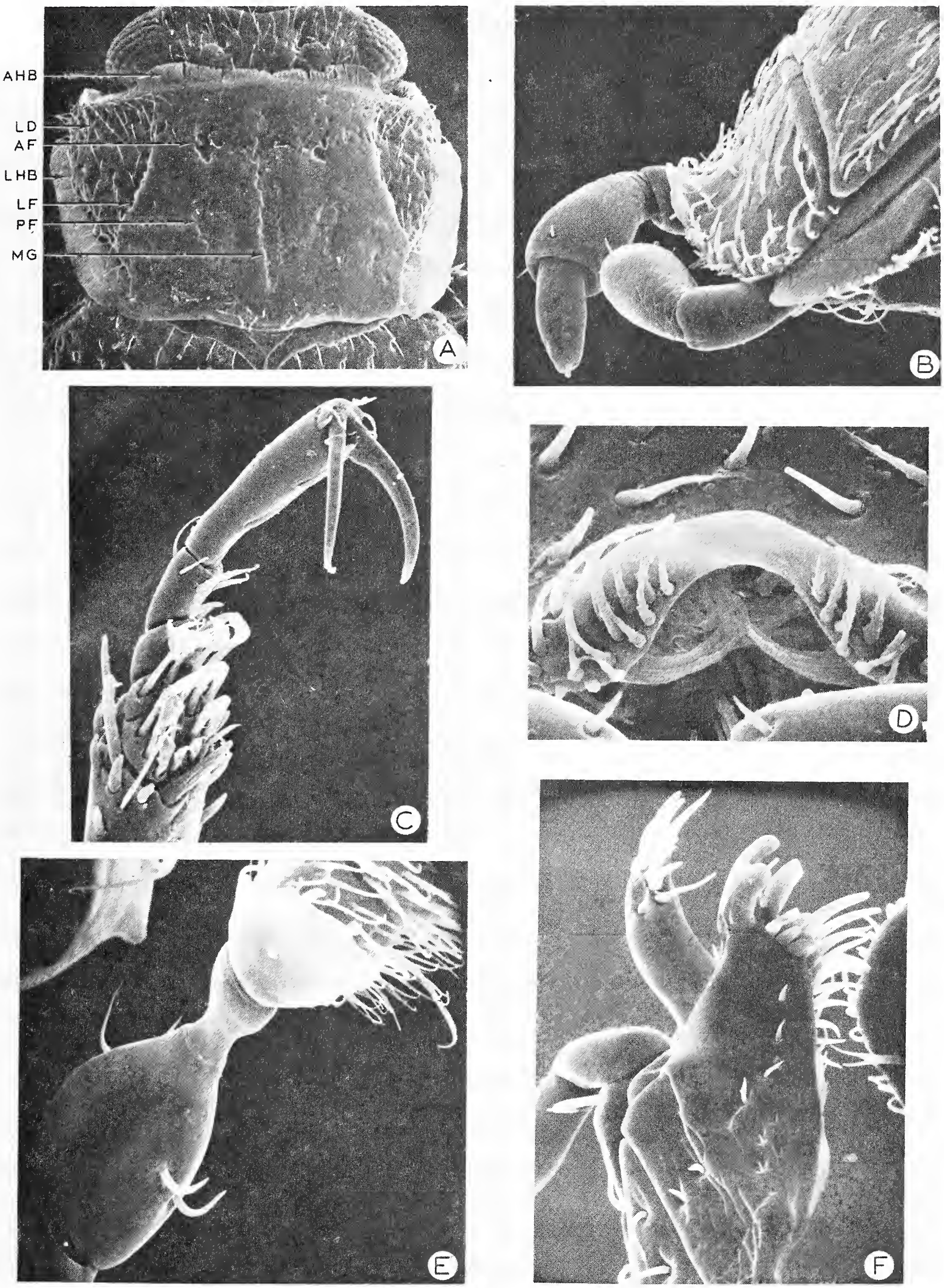
Between 1890 and 1978, taxonomic work on *Ochthebius* consisted of isolated species descriptions, including those by Fall (1910, 1919), Blatchley (1910), Darlington (1928), Brown (1931,1933) and d'Orchymont (1943b). Hatch (1965) provided a key to those species living in the Pacific Northwest, and described three new species. Wood and Perkins (1978) described two new species (*O. leechi* and *O. spanglerorum*) from western North America.

Study of types has revealed the following new synonomies (junior synonyms in parentheses): *similis* Sharp 1882 (*wickhami* Fall 1901); *aztecus* Sharp 1887 (*bruesi* Darlington 1928); *discretus* LeConte 1878 (*insulanus* Brown 1931); *attritus* LeConte 1878 (*schubarti* d'Orchymont 1943); *lineatus* LeConte 1852 (*milleri* Hatch 1965); *interruptus* LeConte 1852 (*aberti* Hatch 1965).

In all, 53 species of *Ochthebius* are now recognized from the Western Hemisphere: 23 were previously described; 30 are new.



Figs. 97A – F, *Ochthebius* body outlines. (A) *O. arenicolus*. (B) *O. pacificus*. (C) *O. lecontei*. (D) *O. sierrensis*. (E) *O. interruptus*. (F) *O. borealis*.



Figs. 98A – F, *Ochthebius* structures. (A) *O. interruptus*, pronotum (AHB = anterior hyaline border, LD = lateral depression, AF = anterior fovea, LHB = lateral hyaline border, LF = lateral fossula, PF = posterior fovea, MG = median groove). (B) *O. interruptus*, palpi and labrum. (C) *O. interruptus* ♂ protarsus, (D) *O. lineatus* ♂, labral emargination. (E) *O. lineatus*, cupule and associated antennal segments. (F) *O. lineatus*, maxilla.

Pronotal features. – The major features of *Ochthebius* pronota (Fig. 98A) include anterior hyaline border (AHB), lateral depressions (LD), anterior foveae (AF), lateral hyaline border (LHB), lateral fossulae (LF), posterior foveae (PF) and median groove (MG). In adults of certain species the foveae and/or median groove are absent or modified. For example, in *O. lineatus* adults (Fig. 103A) the foveae are joined to form longitudinal depressions; in adults of *O. marinus* (Fig. 106A) the foveae are joined to form a transverse depression and the median groove is obsolete; in those of *O. similis* (Fig. 136B) the anterior foveae are absent; and in those of *O. cribricollis* (Fig. 136D) both anterior and posterior foveae are absent. In adults of *O. mexicanus* (Fig. 128A) and related species the pronotum has emarginations behind the eyes, which are termed postocular emarginations.

Diagnosis. – Nine antennomeres , palpal form and lateral hyaline border on the pronotum distinguish adults of *Ochthebius* from those of other genera except *Gymnochthebius*. Most species of *Gymnochthebius* can be discerned by their characteristic pronotal shape, but a few species of the two genera must be distinguished by aedeagal form or amount of hydrofuge pubescence on abdominal sternum 5 (see diagnosis section of *Gymnochthebius*).

Description. – *Form:* Generally elongate-oval, moderately convex, rarely truncate and convex. *Size:* Length 1.30-2.50 mm, width 0.50-1.14 mm. Most females slightly larger than males. *Color:* Most adults dark brown, some with metallic copper or purple reflections, some black, others testaceous. *Head:* Moderately finely punctate to crenulate, generally with well developed microreticulation dorsally. Interocular foveae moderately to well developed. Interocular tuberculi (ocelli) present. Clypeus margin upturned, less so or not in females. Maxillary palpus relatively short, palpomere 3 thickened. Mentum width and length equal. Genae swollen, shiny. Antennomeres nine (4 + 5). *Thorax:* Pronotal form markedly varied, adults of some species with sides weakly sinuate, others deeply incised; hyaline border thin to very wide; anterior depressions generally well developed. Disc of most specimens with anterior and posterior foveae, few specimens with these longitudinally united as sulci, or anterior foveae obsolete; median groove well developed to obsolete. Posterior margin of pronotum slightly arcuate to rear. Prosternum with low median carina ended at coxae; latter contiguous. Metasternum glabrous or pubescent in midregion. *Elytra:* Disc with six rows of punctures between suture and humeri, adults of some species striate-punctate, each puncture with seta. Intervals flat, rounded or costate. Explanate margin slightly to markedly developed. *Abdomen:* Commonly with basal five sterna hydrofuge pubescent, apical two without hydrofuge pubescence; few with sternum 6 hydrofuge pubescent also. *Legs:* Length moderate, slender in some species, stout in others. Males with large pads of suction setae in some species, absent from others. *Genitalia:* Aedeagus with preterminal, mobile piece. Spermatheca as illustrated (Figs. 10A-F).

Key to Subgenera of Western Hemisphere *Ochthebius*

1 Pronotum with sclerotized part sinuate on sides, very shallowly (Figs. 96A,F,97A-F, 98A) or very deeply (Figs. 96D,116A-F); many specimens with acute, produced point at juncture of convex (anterior) and concave (posterior) portions of sinuation (Figs. 125A-F); if concave (posterior) portion very deep (Figs. 116A-C), sides rounded, not angulate as in *Asiobates*. Aedeagus with parameres next to main-piece for their entire length, or nearly so; parameres not divergent from main-piece at their bases (Figs. 114A-E). Range–North, Central and South America and the Galapagos Islands .... *Ochthebius* (*sensu stricto*), p. 305

1′ Pronotum with sclerotized portion transverse, sides gradually rounded from anterior angles to middle or slightly beyond, then excavate (Figs. 96C,E,133A-F,136A-F). Aedeagus with parameres divergent from main-piece at their bases (Figs. 138A-E,141A-D,144A-E). Range–North and Central America .... *Asiobates* Stephens, p. 376

Key to Western Hemisphere species of *Ochthebius (sensu stricto)*

1 (0) Lateral hyaline border of pronotum within sinuation behind lateral depression (Figs. 96D,132B); Appalachian Mountains of eastern United States (*benefossus* Group) . . . . *O. benefossus* LeConte, p 374

1′ Lateral hyaline border extended laterally as far as or beyond lateral depression (Figs. 96A-F,98A); northern South America, Central America, Antilles, and North America except Appalachian Mountains 2

2 (1′) Anterior margin of pronotum with more or less developed postocular emarginations and postocular processes (Figs. 96F,119B,E-H,125A-F,128A); metasternum entirely pubescent, without median glabrous area (*biincisus* Group except *attritus* and *batesoni*) 23

2′ Anterior margin without distinct postocular emarginations; postocular processes absent or extremely small (Figs. 96A,98A,103A,106A,115A); metasternum entirely pubescent or with glabrous area 3

3 (2′) Anterior margin of pronotum bisinuate (Figs. 115A,116A-F)(*bisinuatus* Group) 4

3′ Anterior margin of pronotum straight or arcuate (Figs. 96A,98A,103A,106A) (*interruptus* Group, plus *attritus* and *batesoni*) 9

4 (3) Elytral intervals costate; California (Figs. 116C,118B) . . . . *O. costipennis* Fall, p. 341

4′ Elytral intervals flat or rounded, not costate 5

5 (4′) Pronotal disc crenulate; northern California, Oregon, Idaho (Figs. 116B,114C,D) . . . . *O. crenatus* Hatch, p. 343

5′ Pronotal disc not crenulate 6

6 (5′) Lateral hyaline borders of pronotum broad, with anterior extremes at or very near anterior angles; pronotum rugulose, anterior margin crenulate in front of lateral depressions; California, western Nevada (Figs. 116D,118D) . . . . *O. californicus*, new species, p. 338

6′ Lateral hyaline border less broad, with anterior extremes near anterior 0.33 of lateral depressions; pronotum not rugulose, anterior margin not crenulate . . . 7

7 (6′) Pronotal disc markedly elevated, foveae and median groove very deeply impressed; lateral depressions ended abruptly, with posterior margins thickened; elytral disc subconvex, sloped abruptly from near posterior 0.33 to apices; California (Figs. 116A,118A) . . . . *O. crassalus*, new species, p. 343

7′ Pronotal disc not markedly elevated, foveae and median groove moderately impressed; lateral depressions tapered at posterior extremes, posterior margins not thickened; elytral disc relatively flat, sloped very gradually from near posterior 0.33 to apices; western North America 8

8 (7′) Black, ca. 1.80 mm long; pronotum with anterior margin less distinctly bisinuate; northern California and southern Oregon (Figs. 116E,114E) . . . . *O. richmondi*, new species, p. 339

8′ Brown to dark brown, ca. 1.68 mm long; pronotum with anterior margin more distinctly bisinuate; widely distributed in western North America (Figs. 116F,114B) . . . . *O. bisinuatus*, new species, p. 336

9 (3′) Pronotum with lateral depressions nearly parallel anteriorly, markedly arcuate posteriorly (Figs. 96A,112D-F); metasternum totally pubescent (*rectus*

Subgroup) 10

9′ Pronotum with lateral depressions gradually arcuate (Figs. 98A,106A); metasternum totally pubescent or with median glabrous area 12

10 (9) Small, ca. 1.60 mm long; Colusa County, California (Figs. 112D,113C) .... *O. recticulus*, new species, p. 332

10′ Larger species, ca. 1.80–2.20 mm long 11

11 (10′) Brown, broader, more coarsely punctate, punctural interstices of pronotum generally smaller than punctures; pronotal foveae less apparent, obscured by punctation; pronotum more distinctly setose; coastal areas of western United States and Baja California (Figs. 112F,114A) .... *O. rectusalsus*, new species, p. 331

11′ Black, narrower, less coarsely punctate, punctural interstices of pronotum generally larger than punctures; pronotal foveae more apparent; pronotum less distinctly setose; western North America (Figs. 112E,113A,B) .... *O. rectus* LeConte, p. 329

12 (9′) Pronotum with posterior foveae broadly confluent, not separated by well-defined median groove; if posterior foveae narrowly confluent with median groove, then anterior and posterior foveae of a side united in form of sinuate line (certain specimens of *O. lineatus*) (Figs. 103A,106A,C,E) (*borealis* Subgroup) 13

12′ Pronotum with posterior foveae distinct on each side of median groove; if narrowly confluent with median groove then anterior and posterior foveae of a side distinct, not united in form of sinuate line (Figs. 97A-E,98A) (*interruptus* Subgroup) 17

13 (12) Pronotum and elytra dark brown (northern morph) or testaceous (southern morph); lateral margins of anterior and posterior pronotal foveae of a side united in form of sinuate line or not so; male with anteromedial edge of labrum upturned in form of dentiform process; western and southern Canada south to Colombia (Figs. 98D-F,108C,D,119A) .... *O. lineatus* LeConte, p. 314

13′ Pronotum and elytra brown to black; anterior and posterior foveae of a side not united; males with anteromedial margin of labrum arcuate or slightly emarginate, not upturned in form of dentiform process; northern and western North America 14

14 (13′) Posterior pronotal foveae oval, with lateral and medial extremes similar in appearance, both gradually sloped; microreticulation of pronotal foveae and lateral depressions uniform; coastal areas of Washington, Oregon and California (Figs. 105B,110D) .... *O. uniformis*, new species, p. 321

14′ Posterior pronotal foveae generally not oval, magins ended abruptly, lateral margins of foveae in form of straight line or not; microreticulation of pronotal foveae and lateral depressions uniform or not 15

15 (14′) Black; interfoveal area of pronotum at least partially to totally microreticulate; metasternal median area glabrous; elytral intervals flat (Figs. 97F,106E,F,110A-C) .... *O. borealis*, new species, p. 322

15′ Brown; interfoveal area with or without microreticulation; metasternal median area glabrous or pubescent; elytral intervals flat or rounded 16

16 (15′) Elytral intervals rounded, somewhat elevated; metasternal median area varied from glabrous in posterior 0.20 to totally pubescent (Figs. 105C,106C,D,108A)

. . . . *O. kaszabi* Janssens, p. 325

16′ Elytral intervals flat; metasternal median area glabrous in posterior 0.50 (Figs. 105A,106A,B,108B) . . . . *O. marinus* (Paykull), p. 318

17 (12′) Metasternum with large median glabrous area 18

17′ Metasternum entirely pubescent 20

18 (17) Median groove lightly impressed, or absent in middle of pronotum; postocular processes absent; pronotal punctation lightly impressed; males with anteromedial margin of labrum upturned, but not in form of prominent dentiform process; southern British Columbia south to northeastern Nevada (Figs. 97C,100C) . . . . *O. lecontei*, new species, p. 308

18′ Median groove more markedly impressed, not absent from middle of pronotum; postocular processes more or less developed; pronotal punctation generally more markedly impressed; males with anteromedial margin of labrum upturned in form of prominent dentiform process 19

19 (18′) Body slightly more parallel sided; color generally darker; postocular processes generally less prominent; pronotal sculpture generally less markedly impressed; Galapagos Islands (Figs. 119D,143D) . . . . *O. batesoni* Blair, p. 349

19′ Body slightly less parallel sided; color generally lighter, many specimens with testaceous pronotum and elytra; postocular processes generally more prominent; pronotal sculpture generally more markedly impressed; areas bordering Gulf of Mexico and Caribbean Sea, including Florida, Texas, Yucatan, Colombia, Cuba, Dominican Republic and Puerto Rico (Figs. 102A-D,119C) . . . . *O. attritus* LeConte, p. 346

20 (17′) Pronotum with origin of lateral hyaline borders at or very slightly posterior to anterior angles (Figs. 97E,98A,100D) . . . . *O. interruptus* LeConte, p. 311

20′ Origin of lateral hyaline borders posterior to anterior angles of pronotum, near midlength of lateral depressions (Figs. 97A,B,D) 21

21 (20′) Brown; extremely slight indication of postocular emarginations of pronotum; California, western slope of Sierra Nevada mountains (Figs. 97D,118C) . . . . *O. sierrensis*, new species, p. 313

21′ Black; no indication of postocular emarginations; California, coastal mountain ranges (Figs. 97A,B) 22

22 (21′) Body shorter, wider, elytral length less than twice pronotal width (Figs. 97B,100A) . . . . *O. pacificus*, new species, p. 306

22′ Body longer, narrower, elytral length greater than twice pronotal width (Figs. 97A,100B) . . . . *O. arenicolus*, new species, p. 307

23 (2) Abdominal sternum 6 with hydrofuge pubescence (Figs. 96F,119B,120A-D) . . . . *O. aztecus* Sharp, p. 359

23′ Abdominal sternum 6 without hydrofuge pubescence 24

24 (23′) Pronotum with median groove strongly constricted in midregion, anterior and posterior portions oval; anterior foveae distinctly separated from median groove by shiny relief (Figs. 112A,C,125D) 25

24′ Pronotum with median groove absent, markedly reduced, or markedly confluent with anterior and posterior foveae, anterior and/or posterior portions of median

groove indistinguishable from confluent foveae 27

25 (24) Black; postocular emarginations deep; processes behind lateral depressions well developed; lateral hyaline borders convergent to base; coastal areas of California and Oregon (Figs. 125D,126A) .... *O. biincisus*, new species, p. 361

25′ Brown; postocular emarginations shallow; processes behind lateral depressions very small or absent; lateral hyaline borders nearly parallel sided; Rocky Mountain region of United States (Figs. 112A,C) 26

26 (25′) Male genitalia and body outline as illustrated (Figs. 112C,124A) .... *O. spanglerorum* Wood and Perkins, p. 359

26′ Male genitalia and body outline as illustrated (Figs. 112A,124B) .... *O. alpinopetrus*, new species, p.357

27 (24′) Pronotum with area between posterior foveae flat, surface smooth and shiny between punctures (Figs. 125A,126B) .... *O. obscurus* Sharp, p. 372

27′ Pronotum with posterior foveae more or less confluent, microreticulate 28

28 (27′) Pronotum with areas between fossulae and posterior foveae dull, microreticulate 29

28′ Areas between fossulae and posterior foveae shiny, non-microreticulate or very faintly so 32

29 (28) Pronotum with lateral depressions distinctly convex, somewhat inflated 30

29′ Lateral depressions flat, not inflated 31

30 (29) Pronotum with postocular emarginations deeper; coastal ranges of southern Oregon, California and Baja California (Figs. 119F,120E) .... *O. sculptus* LeConte, p. 352

30′ Postocular emarginations shallower; western North America (Figs. 119G,H,122A-F) .... *O. sculptoides* new species, p. 351

31 (29′) Smaller, ca. 1.60 mm long; postocular emarginations deeper; male labral emargination deeper; color copperish in many specimens; median groove generally not connected to deeply confluent posterior foveae; northern Mexico to Guatemala (Figs. 119E,129A-C) .... *O. mesoamericanus*, new species, p. 373

31′ Larger, ca. 1.77 mm long; postocular emarginations shallower; male labral emargination shallower; color dark brown or black; median groove generally connected to confluent posterior foveae; western United States, northern Mexico (Figs. 112B,124C,D) .... *O. tubus*, new species, p. 355

32 (28′) Pronotum with shallow postocular emarginations (Figs. 125E,F) 33

32′ Pronotum with deep postocular emarginations (Figs. 125B,C) 34

33 (32) Elytra striate-punctate; Oaxaca, Mexico (Figs. 125F,129D) .... *O. pauli*, new species, p.368

33′ Elytral rows of punctures not striate; southeastern Arizona, northern Mexico (Figs. 125E,131B) .... *O. madrensis*, new species, p. 366

34 (32′) Pronotum with postocular emarginations very deep; lateral depressions with posterior process large; foveae and median groove deep; elytra shallowly striate-punctate; Mexico (Figs. 125C,128A-F,129E) .... *O. mexcavatus*, new species, p. 368

34′ Pronotum with postocular emarginations moderately deep; lateral depressions with posterior processes small; foveae and median groove very shallow; elytra

not striate–punctate; southern California, northern Baja California, Arizona . 35
35 (34′) Aedeagus with apical piece markedly arcuate, thin border wide; apex of main-piece wider, less acute; coastal mountains of southern California, northern Baja California (Figs. 125B,126C) . . . . *O. gruwelli*, new species, p. 365
35′ Aedeagus with apical piece not markedly arcuate, thin border very narrow; apex of main-piece thinner, more acute; eastern Arizona (Fig. 126D) . . . . *O. arizonicus*, new species, p. 366

Key to Western Hemisphere species of *Ochthebius (Asiobates)*

1 (0) Large (ca. 2.10–2.80 mm long), coarsely punctate (Figs. 133A,C,136A,C); aedeagus without process on terminal piece (Figs. 144A-E) (*puncticollis* Group) 2
1′ Medium to small (ca. 1.60-2.20 mm long); aedeagus with process on terminal piece (Figs. 141A,B,D) (*discretus* Group) 5
2 (1) Pronotum without postocular emarginations (Fig. 133C) . . . . *O. leechi* Wood and Perkins, p. 403
2′ Pronotum with postocular emarginations 3
3 (2′) Pronotum with sides of lateral depressions angulate in middle; southern Texas, northern Mexico (Figs. 96C,136A) . . . . *O. angularidus*, new species, p. 402
3′ Pronotum with sides of lateral depressions gradually arcuate, not angulate in middle; California, Baja California, Arizona and Utah 4
4 (3′) Elytra broadly explanate, flange as wide as tibia; pronotal lateral hyaline borders markedly convergent to base (Fig. 136C) . . . . *O. martini* Fall, p. 400
4′ Elytra not broadly explanate, flange not as wide as a tibia; pronotal hyaline borders not markedly convergent to base (Fig. 133A) . . . . *O. puncticollis* LeConte, p. 399
5 (1′) Pronotum with well developed anterior foveae (*discretus* Subgroup) 6
5′ Pronotum without anterior foveae, this region flat and moderately punctate or somewhat depressed and densely, coarsely punctate 10
6 (5) Blackish, more linear and less convex; lateral depressions generally more concave at rear and more markedly punctate; common; western North America (Figs. 96E,133D,134A,B) . . . . *O. discretus* LeConte, p. 377
6′ Brownish, more ovate and more convex species; lateral depressions less concave at rear and less markedly punctate; rare 7
7 (6′) Pronotum with lateral depressions slightly deflexed in anterior 0.50, typically subangulate laterally; postocular emarginations and processes well developed; posterior angles of sclerotized part of pronotum in form of produced point; United States, Pacific Northwest and British Columbia, Canada (Figs. 133E,138A) . . . . *O. mimicus* Brown, p. 383
7′ Pronotum with lateral depressions in same plane throughout, without deflexion in anterior 0.50, typically arcuate laterally; postocular emarginations and processes small or absent; posterior angles of pronotum not distinctly acute;

California to northern Canada 8

8 (7′) Pronotum finely, sparsely punctate; lateral depressions shorter, ended near midlength of pronotum; lateral hyaline border wider along lateral depressions; Oregon and northern Northwest Territories (Figs. 132C,134C) . . . . *O. hibernus*, new species, p. 381

8′ Pronotum deeply, moderately coarsely and densely punctate; lateral depressions larger, ended past midlength of pronotum; lateral hyaline border narrower along lateral depressions 9

9 (8′) Large (ca. 1.96-2.00 mm long); puncture density on pronotal disc rather uniform throughout; median groove shallower; Marin County, California and Multnomah County, Oregon (Figs. 133B,141B) . . . . *O. orbus*, new species, p. 382

9′ Small, more convex (1.44 mm long); punctures on pronotal disc dense along median groove, sparse laterally; median groove deeper; Putnam County, Indiana (Fig. 133F) . . . . *O. putnamensis* Blatchley, p. 385

10 (5′) Pronotum densely, coarsely punctate in region generally occupied by anterior foveae, in many specimens this region transversely depressed; posterior foveae present (*reticulocostus* Subgroup) 11

10′ Pronotum flat and sparsely punctate in region usually occupied by anterior foveae; posterior foveae present or absent 15

11 (10) Pronotum without postocular emarginations; Arizona, New Mexico, Texas, probably northern Mexico (Figs. 136E,141D) . . . . *O. apache*, new species, p. 391

11′ Pronotum with well developed postocular emarginations 12

12 (11′) Dorsum markedly, completely microreticulate; elytral intervals costate 13

12′ Pronotal disc without microreticulation on punctural interstices; elytral intervals costate or not, but not markedly microreticulate 14

13 (12) Smaller, narrower, ca. 1.64 x 0.76 mm (Fig. 140A); microreticulation more markedly developed; Nayarit and Mexico, Mexico . . . . *O. reticulocostus*, new species, p. 394

13′ Larger, broader, ca. 2.28 x 1.04 mm (Fig. 140C); microreticulation less markedly developed; Mexico, Mexico . . . . *O. mexicanus*, new species, p. 394

14 (12′) Body short, stout, spindle shaped (Fig. 136E); elytral intervals subcostate; mountains of southern Mexico and Guatemala . . . . *O. apicalis* Sharp, p. 397

14′ Body not especially stout or spindle shaped (Fig. 140B); elytral intervals less elevated; Mexico, Mexico . . . . *O. browni*, new species, p. 393

15 10′ Pronotum with posterior foveae; Arizona, Mexico (Figs. 136B,138B) (*similis* Subgroup) . . . . *O. similis* Sharp, p. 385

15′ Pronotum without posterior foveae; Pacific Coast states of U.S.A., transcontinental near Canada-U.S.A. border (*cribricollis* Subgroup) 16

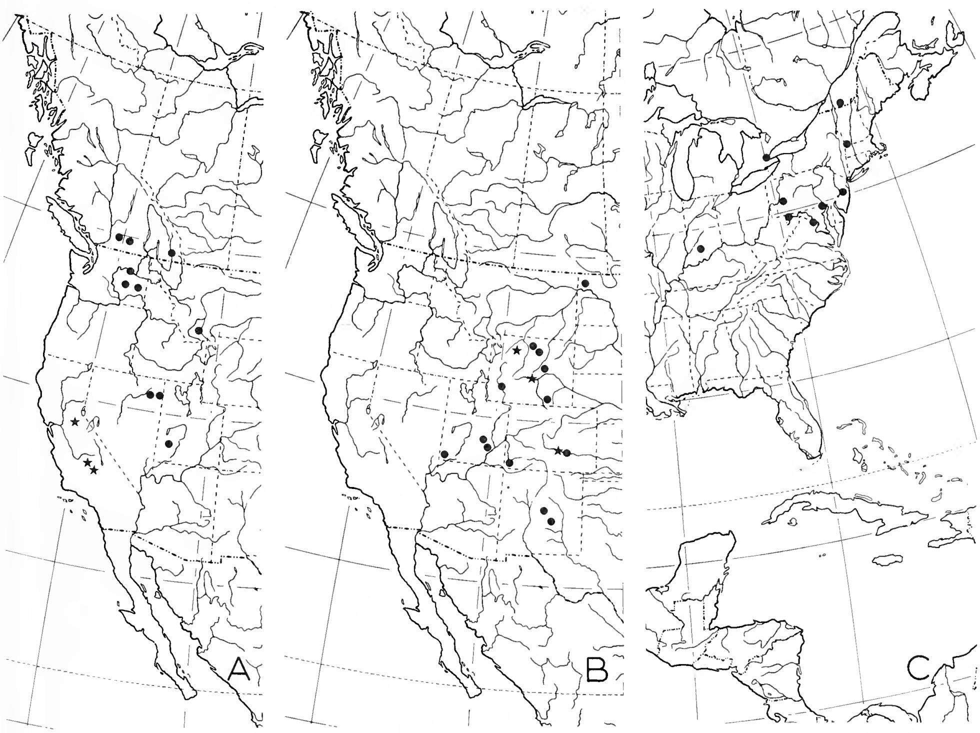
16 (15′) Pronotum with shallow transverse depression at posterior end of median groove; elytra shorter in relation to pronotal length; southern British Columbia, Washington, Oregon and northern California (Figs. 136F,138E) . . . .

. . . . *O. brevipennis*, new species, p. 389

16′ Pronotum without shallow transverse depression at posterior end of median groove; elytra longer in relation to pronotal length; Quebec west to British Columbia, then south to southern California (Figs. 136D,138C,D) . . . .
. . . . *O. cribricollis* LeConte, p. 388

Ochthebius (*sensu stricto*) Leach

As is described in the key to the subgenera, adults of *Ochthebius (sensu stricto)* are distinguished from those of *O. (Asiobates)* by pronotal and aedeagal differences.



Figs. 99A – C, Geographical distributions of *Ochthebius* species. (A) *O. lecontei* ● and *O. sierrensis* ★. (B) *O. spanglerorum* ● and *O. alpinopetrus* ★. (C) *O. benefossus*.

The *interruptus* Group

Members of this group are characterized by shape of the anterior pronotal margin, which varies from straight to moderately arcuate. Dorsal form and sculpture vary considerably within the group, which includes three subgroups.

Thirteen species currently comprise the group, which has a very extensive range, and includes two holarctic species (*O.marinus* and *O. kaszabi*). The Western Hemisphere components are widespread in North, Central and northern South America. One species (*O. batesoni*) is in the Galapagos Islands. Species are notably absent from the Appalachian Mountains of the eastern United States.

The *interruptus* Subgroup

Adults of species in this subgroup are characterized by pronotal shape and sculpture. The lateral depressions are not markedly arcuate posteriorly, hence the sides of the pronotum are gradually sinuate (Fig. 98A). Posterior foveae are usually distinct on each side of the median groove, but in some adults are narrowly confluent with the median groove. In the latter specimens, the anterior and posterior foveae of a side are distinctly separated from one another, not united to form a sinuate line.

Geographical distribution of this lineage (Fig. 183) is restricted to western North America.

1. *Ochthebius pacificus* new species
(Figs. 97B,100A,101A,183)

Type-locality. – Sonoma, Sonoma County, California, U.S.A.

Type-specimens. – The holotype male and allotype are deposited in CAS. Both specimens were collected by H.B. Leech in 1950, and have identical locality data. Data about paratypes (230) are presented in the appendix.

Diagnosis. – *O. pacificus* adults are externally very similar to those of *O. arenicolus* in that both groups are small and black with the anterior margin of the pronotum straight and generally with pronotal foveae well separated from the median groove. Ordinarily, *O. arenicolus* adults have the posterior foveae more distinctly separated from the median groove than have *O. pacificus* adults. However, overlap in this characteristic makes it unreliable for purposes of determination. Likewise, although the median emargination of the labrum is generally deeper in *O. pacificus* adults, there is some overlap which negates this structure as a distinguishing characteristic. The most consistent external character of diagnostic value is body form (Figs. 97A,B). *O. pacificus* adults are more robust, with the elytral length less than twice the pronotal width; *O. arenicolus* adults are less robust, with the elytral length more than twice the pronotal width. Unequivocal identification should be based upon the aedeagal shapes, which are quite dissimilar (Figs. 100A,B).

Description. – *Form:* Ovate, weakly convex (Fig. 97B). *Size:* Holotype 1.60 mm long, 0.80 mm wide. *Color:* Head and pronotum black; elytra dark brown; venter dark brown; legs and palpi brown. *Head:* Length 0.28 mm; width 0.42 mm. Frons with lightly impressed punctures rather small, separated by twice puncture diameter; microreticulation more evident in lateral areas; surface moderately shining in midline, without obvious hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi moderately large and distinct; basomedial fovea nearly as

deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with fine, contiguous microreticulation and fine hairs. Labroclypeal suture straight. Labrum length nearly 0.50 width; surface with fine, irregularly spaced punctures and rather dense hairs; median emargination shallow and narrow, depth nearly 0.25 length of labrum, width 0.13 width of labrum, edge upturned, semi-transparent; in habitus view emargination appears smaller than it is. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 slightly greater than 0.50 length of 3. Mentum nearly square, anterior margin arcuate, shining, with moderately dense, deep punctures. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.38 mm; maximum width (at approximately midlength)0.59 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near anterior 0.50 of lateral depression, slightly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum straight, without crenulations in front of lateral fossulae; with extremely shallow excavation in front of each lateral depression; anterior angles obtuse. Lateral depressions slightly convex, with microreticulation and small indistinct hairs; margins moderately arcuate, pronotum moderately constricted behind lateral depressions. Lateral fossulae with inner margin abrupt, posterior extreme tapered into lateral hyaline border . Pronotal disc moderately convex, microreticulation markedly impressed in and at margins of median groove and foveae, area between groove and foveae with microreticulation extremely finely impressed, surface therefore rather shiny; punctation in shiny area sparse and moderately large; hairs sparse and fine. Median groove moderately deep and wide, tapered at ends, extended nearly to anterior and posterior margins; with punctation more markedly impressed than that of disc. Anterior foveae rather shallow, suboval, connected to median groove by very shallow depression, latter with markedly impressed microreticulation; lateral and medial margins indistinct. Posterior foveae oval, elongate and oblique, length slightly greater than twice width, width twice that of median groove; surface sculpture as in median groove; all margins not ended abruptly. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 1.00 mm; maximum width (near midlength) 0.72 mm. Disc somewhat flattened, moderately dull, with six rows of punctures between suture and humeri. Elytra sloped gradually to posterior, without marked declivity; most punctures slightly elongate; intervals flat, width equal to puncture diameter; interstices between punctures 0.25 puncture diameter; each puncture with very small, indistinct seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Medium build and length; ratio of hind leg length to abdominal length 1.5/1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 100A)(45 examined).

Variation. – This species is relatively constant throughout its rather limited range. Some specimens have the posterior pronotal foveae joined by a very shallow depression, but the median groove is quite apparent between the posterior foveae. Degree of development of the median emargination of the labrum (in both sexes) is also subject to slight variation. Other variation seen in certain specimens includes; 1) elytra black instead of dark brown; 2) lateral margins of posterior foveae ended abruptly instead of gradually; 3) excavations in front of lateral depressions clearly evident instead of nearly imperceptible; and 4) microreticulation of pronotal disc between foveae and median groove absent instead of very lightly impressed. Females lack the protarsal suction setae of males, and have the labral margin on the same plane as remainder instead of being upturned.

Distribution. – (Figs. 101A,183). Ranges along the Pacific coastal region from Washington south to southern California. One locality from southern Nevada known.

Etymology. – Latin, *pacificus* (peaceful). I refer to the geographical distribution.

2. *Ochthebius arenicolus* new species
(Figs. 97A,100B,101B,183)

Type-locality. – Tributary of E. branch Little Indian Creek, 6.2 mi. S. Lodoga, Colusa Co., California, U.S.A.

Type-specimens. – Holotype male and allotype deposited in CAS. Hugh B. Leech collected these specimens, which have the same locality data, in 1966. Data about paratypes (320) are presented in the appendix.

Diagnosis. – Adults of this species are easily confused with those of *O. pacificus.* Refer to the latter species for a comparison of external characters.

Description. – *Form:* Ovate, moderately convex (Fig. 97A). *Size:* Holotype 1.66 mm long, 0.72 mm wide. *Color:* Dorsum and venter black; legs and palpi brown. *Head:* length 0.28 mm; width 0.44 mm. Frons with microreticulation in lateral areas; punctures in midline only, separated by twice puncture diameter or greater; surface shining, without obvious hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large, distinct; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, microreticulate; punctures very lightly impressed, with fine, obvious hairs. Labroclypeal suture straight. Labrum length 0.50 width; surface with fine punctures and fine, moderately dense hairs; median emargination shallow and narrow, depth 0.20 length of labrum, width 0.20 width of labrum, edge upturned; in habitus view emargination apparently smaller. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of penultimate. Mentum square, anterior margin arcuate; moderately shining, with dense, deep, small punctures. Submentum evenly, finely punctulate, punctures contigous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.38 mm; maximum width (near anterior 0.33) 0.58 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near anterior 0.33 of lateral depression, extended slightly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum straight, without crenulations in front of lateral fossulae and without shallow excavations in front of each lateral depression; anterior angles obtuse. Lateral depressions slightly convex, with punctation and small indistinct hairs; margins moderately arcuate, pronotum moderately constricted behind lateral depressions. Lateral fossulae with inner margin abrupt, posterior extremely tapered into lateral hyaline border. Pronotal disc moderately convex, microreticulate, punctation well developed in median groove and foveae; area between foveae and median groove with punctures only, punctures separated by twice puncture diameter, surface shiny. Median groove moderately deep and wide, tapered at ends, extended nearly to anterior and posterior margins; punctate and microreticulate. Anterior foveae rather shallow, suboval, connected to median groove by very shallow microreticulate depression, lateral margin straight and nearly parallel to median groove; median margin arcuate. Posterior foveae oval, elongate and oblique, length slightly greater than twice width, width twice that of median groove; surface sculpture as in median groove; lateral margin ended slightly more abruptly than median. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum without glabrous area. *Elytra:* Length 1.12 mm; maximum width (near midlength) 0.76 mm. Disc somewhat flattened, moderately dull, with six rows of punctures between suture and humeri. Elytra sloped gradually to posterior, without marked declivity; most punctures slightly elongate; intervals flat, width 0.50 puncture diameter; interstices between punctures 0.25 puncture diameter; each puncture with small seta. Explanate margin rather narrow. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very short hairs. *Legs:* Of medium build and length; ratio of hind leg length to abdominal length 1.8:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 100B)(76 examined).

Variation. – Other than minor variations in depth of pronotal foveae, populations are relatively uniform throughout the range of this species. Further discussion of variation is presented in the diagnosis of *O. pacificus.* Females lack the upturned edge of the labral emargination and protarsal suction setae.

Distribution. – (Figs. 101B,183) Coastal mountain ranges of southern Oregon, California and Baja California.

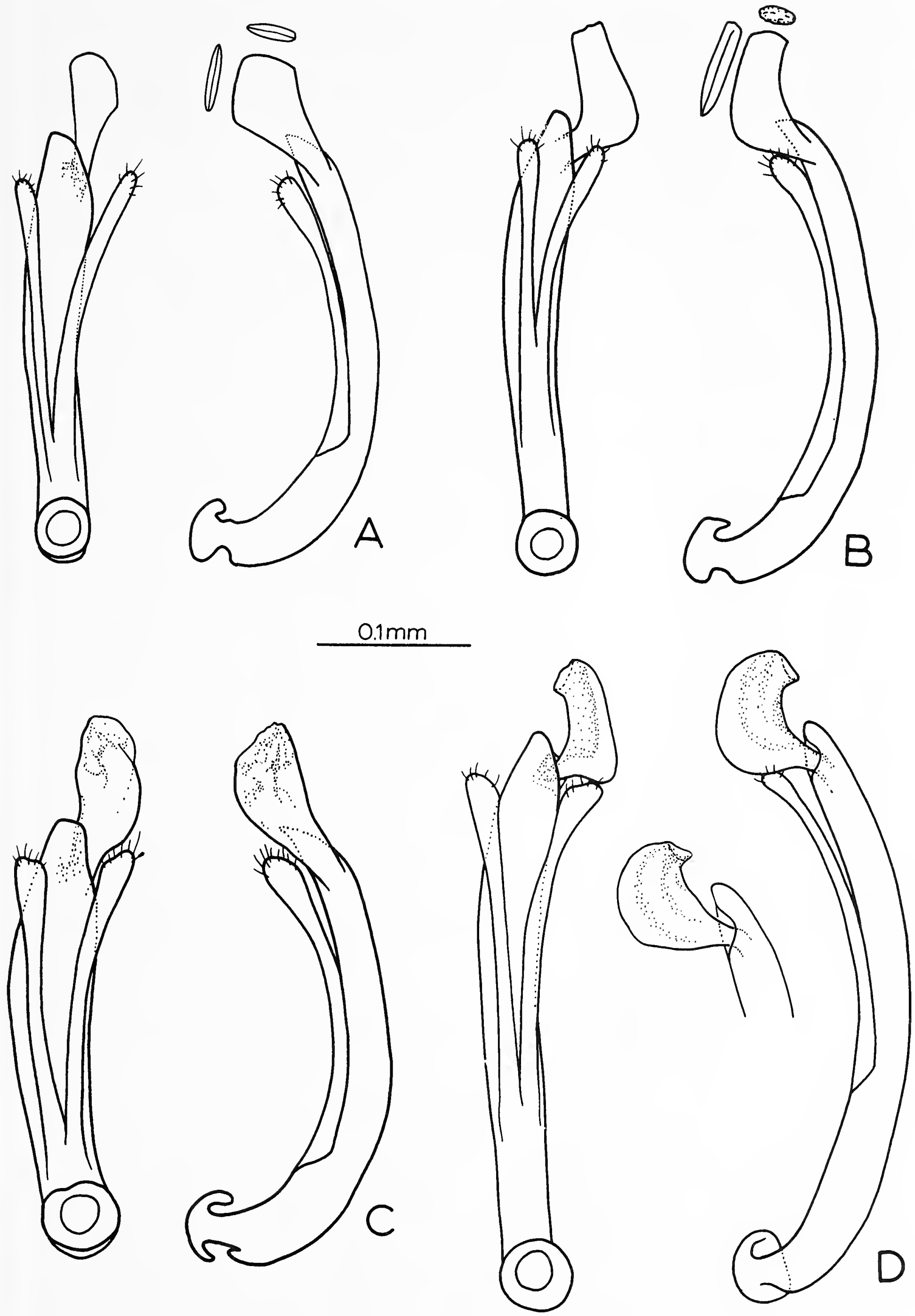
Etymology. – Latin, *arena* (sandy place) plus *icolus* (dweller). Individuals live at margins of sandy streams.

3. *Ochthebius lecontei* new species
(Figs. 97C,99A,100C,183)

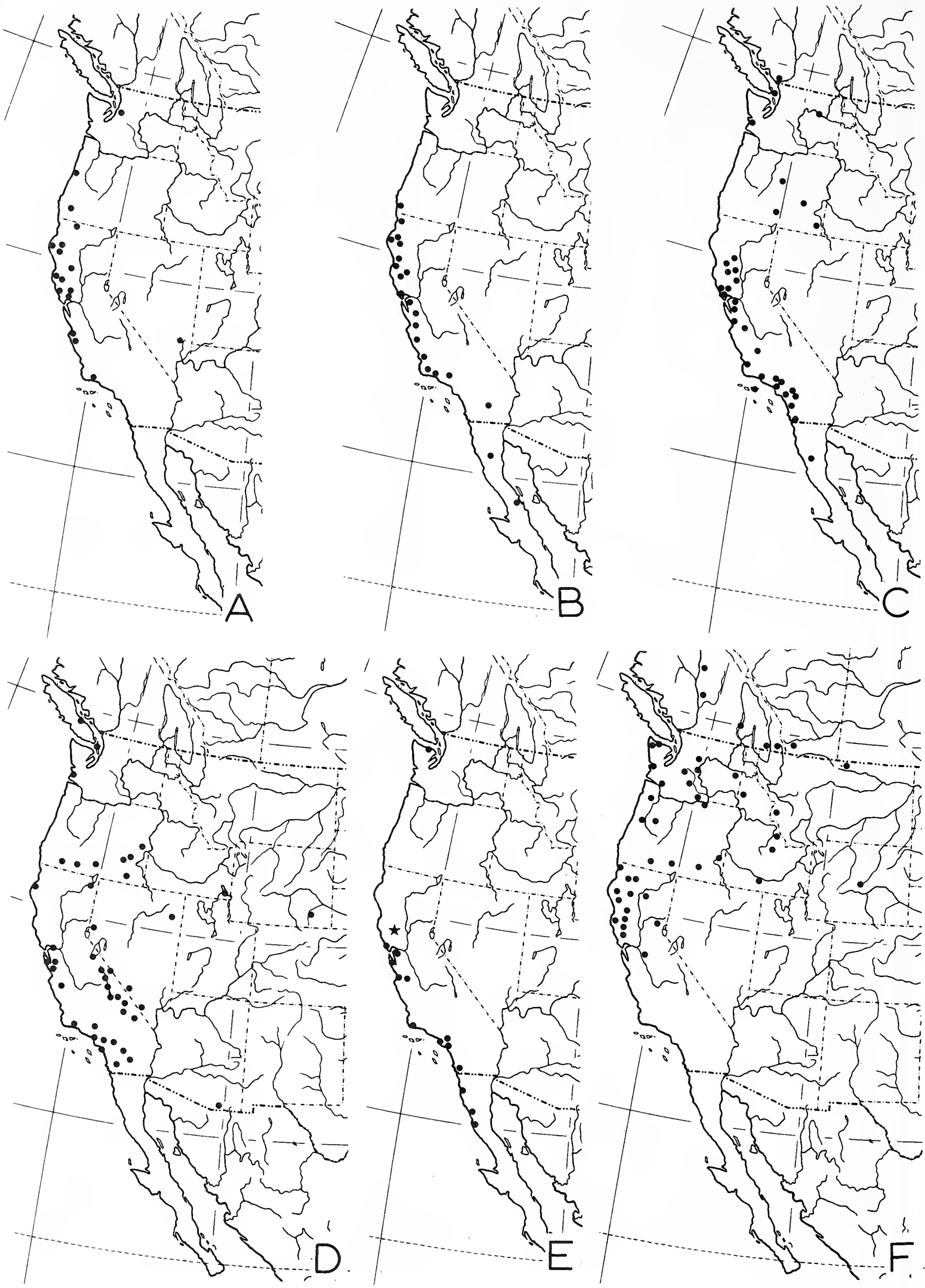
Type-locality. – Ski-jump pond, Vernon, British Columbia, Canada.

Type-specimens. – The holotype male and allotype are deposited in CAS. Both specimens were collected in Vernon by Hugh B. Leech; the holotype in 1942, the allotype from "pond 3" in 1941. Data about paratypes (44) are presented in the appendix.

Diagnosis. – Dorsally adults look rather like very small adults of *O. interruptus.* Ventrally they are quite dissimilar, as the metasternum is totally hydrofuge pubescent in *O. interruptus,* but has a large glabrous area in *O. lecontei.* The more lightly impressed pronotal sculpture of *O. lecontei,* plus widely separated distributions, and aedeagal form discriminate between *O.*



Figs. 100A – D, Aedeagi of *Ochthebius* species. (A) *O. pacificus*, holotype. (B) *O. arenicolus*, holotype. (C) *O. lecontei*, holotype. (D) *O. interruptus*, specimen from Mendocino County, California (inset: Lake County, Oregon, drawn from paratype of *O. aberti* Hatch).



Figs. 101A – F, Geographical distributions of *Ochthebius* species. (A) *O. pacificus*. (B) *O. arenicolus*. (C) *O. interruptus*. (D) *O. rectus*. (E) *O. rectusalsus*, ● and *O. recticulus* ★. (F) *O. bisinuatus*.

lecontei and the two closely similar species with glabrous metasterna: *O. attritus* and *O. batesoni*.

Description. – *Form:* Ovate, weakly convex (Fig. 97C). *Size:* Holotype 1.56 mm long, 0.72 mm wide. *Color:* Dorsum and venter dark brown; legs and palpi light brown. *Head:* Length 0.26 mm; width 0.42 mm. Frons with very small, sparse punctures, surface shiny, without obvious hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi moderately large; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; microreticulation in posterior 0.50, anterior 0.50 shiny, with very fine, sparse punctures; with fine, very sparse hairs. Labroclypeal suture straight. Labrum length nearly 0.50 width; surface with fine punctures and moderately dense hairs; median emargination very shallow with edge strongly upturned; in habitus view upturned edge obscured by emargination, anterior margin apparently entire. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, moderately shining, with sparse, small punctures; anterior margin arcuate. Submentum evenly, finely punctulate. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (near anterior 0.33) 0.54 mm. Anterior hyaline border moderately wide in front of disc, considerably wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near anterior 0.33 of lateral depression, extended slightly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum arcuate, without crenulations in front of each lateral depression; anterior angles obtuse. Lateral depressions flat, with microreticulation, small punctures, and small hairs; margins moderately arcuate; pronotum moderately constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, punctures extremely fine and very sparse; with fine, sparse hairs; surface between punctures smooth and shiny. Median groove apparent in anterior and posterior as very shallow, smooth depression, middle of disc slightly elevated and without groove. Anterior foveae shallow, elongate ovals separated from median groove by four times fovea width; connected to median groove by very shallow, smooth depression with denser punctation than that of remainder of pronotum. Posterior foveae elongate grooves separated from median area by four times fovea width; shallow depression connecting fovea to median groove. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.00 mm; maximum width (near midlength) 0.72 mm. Disc slightly rounded, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity beginning near posterior 0.33; most punctures somewhat elongate; intervals flat, width equal puncture width; interstices between punctures 0.50 puncture length; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.7:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 100C)(18 examined).

Variation. – Specimens from British Columbia are ordinarily darker and have the pronotal sculpture less impressed. In southern populations the pronotal groove is complete in some specimens, not obsolete in the midregion as it is in the holotype.

Distribution. – (Figs. 99A,183). An unusual distribution, with specimens from the Great Basin (southwestern Utah; northeastern Nevada), the Columbia Plateau (western Washington) and southern British Columbia. One locality is known in the Rocky Mountains of southwestern Montana.

Etymology. – Dedicated to J. L. LeConte, in recognition of his contributions to the taxonomic literature of North American *Ochthebius*.

4. *Ochthebius interruptus* LeConte
(Figs. 97E,98A-C,100D,101C,183)

Ochthebius interruptus LeConte, 1852:210 (holotype female in MCZ; type-locality: San Diego, California, U.S.A.). – LeConte, 1855:361. – LeConte, 1878:379. – Horn, 1890:23. – Darlington, 1928:3. – Leech and Chandler, 1956:333. – Hatch, 1965:17.

Ochthebius aberti Hatch, 1965:18 (holotype female in UWA; type-locality: Abert Lake, Lake County, Oregon, U.S.A.; new synonomy).

LeConte's holotype is damaged, the head plus prothorax being severed from the pterothorax, as is the left elytron. These body parts are glued to the point with the remainder of the specimen. I have illustrated (Fig. 100D) the apex of the adeagus of a paratype of *O. aberti* Hatch.

Diagnosis. – Form of the pronotum (Fig. 98A) with its arcuate anterior margin, broad hyaline borders which attain the anterior angles and the weakly convex disc with its distinct foveae and median groove serve to distinguish adults of this species from others of the genus.

Description. – *Form:* Ovate, moderately convex (Fig. 97E). *Size:* Holotype 1.62 mm long, 0.73 mm wide. *Color:* Dorsum and venter dark brown; legs and palpi light brown. *Head:* Length 0.30 mm; width 0.40 mm. Frons with moderately large, dense punctures in midline, surface shiny, with very fine hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi moderately large; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with microreticulation, moderately dense punctures, and fine hairs. Labroclypeal suture straight. Labrum length 0.33 width; surface with small punctures and fine, dense hairs; median emargination of moderate depth. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, markedly shining, with sparse, small punctures; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.38 mm; maximum width (near anterior 0.33) 0.56 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin slightly posterior to anterior angles, extended arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum arcuate, without crenulations in front of lateral fossulae and without shallow excavation in front of each lateral depression; anterior angles acute. Lateral depressions flat, with punctures, microreticulation, and fine hairs; margins moderately arcuate. Pronotum moderately constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, punctures moderately large, separated by one-two times puncture diameter; with fine, sparse hairs; surface between punctures smooth and shiny. Median groove microreticulate, moderately deep, moderately wide, tapered at anterior and posterior, not extended to anterior and posterior margins; Anterior foveae oval, moderately large, separated from median groove by width of fovea; connected to median groove by shallow depression. Posterior foveae oval, oblique, with abrupt lateral margins; posteromedial areas connected to median groove by very shallow depression; surface sculpture as in median groove. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 1.00 mm; maximum width (near midlength) 0.72 mm. Disc slightly rounded, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; most punctures somewhat elongate; intervals rounded, width 0.50 puncture width; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* All legs moderately long and slender; ratio of hind leg length to abdominal length 1.7/1. Protarsomeres without suction setae. *Genitalia:* Male (Fig. 100D)(68 examined).

Variation. – The following variation was noted; 1) specimens from Baja California have a median glabrous area on the metasternum; 2) pronotal sculpture reaches its smooth extreme in specimens from San Benito County, California; and 3) some specimens from Oregon have the elytra shorter than is commonly seen. The aedeagus of *O. aberti* Hatch (Fig. 100D) does not differ significantly from other examples studied. A total of 692 specimens were examined (see appendix).

Natural History. – *O. interruptus* has a rather wide ecological tolerance, populations living at the margins of lotic, lentic, and brackish aquatic habitats. Habitat descriptors include "wet edge of Clear Lake", "farm pond", "fresh pool, SE shore L. Abert", and "margins of hot springs". Halophilic habits are indicated by such locality descriptors as "brackish pond", "tide pool", "on mud, salt flat", and "salt marsh". I.Moore collected 276 specimens from a salt marsh in Baja California, demonstrating that *O. interruptus* can achieve high population densities in brackish water habitats.

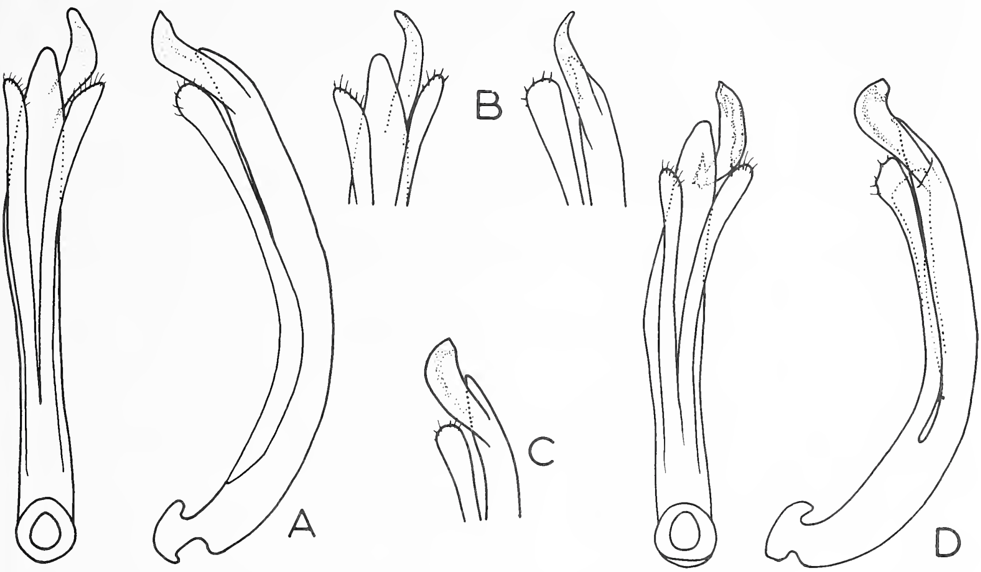
Distribution. – (Figs. 101C,183). From southern British Columbia south through the coastal mountains of Washington, Oregon and California to northern Baja California.

Remarks. – I have seen more instances of misidentifications involving *O. interruptus* than any other previously described species in the genus.

5. *Ochthebius sierrensis* new species
(Figs. 97D,99A,118C,183)

Type-locality. – Squaw Valley, Fresno County, California, U.S.A.

Type-specimens. – The holotype male and allotype, which have identical label data, are deposited in CAS. They were collected by P.S. Bartholomew in 1955. Data about paratypes (15) are listed in the appendix.



Figs. 102A – D, Aedeagi of *Ochthebius attritus*. (A) Monroe County, Florida. (B) Puerto Rico. (C) Pernambuco, Brazil (drawn from holotype of *O. schubarti* d'Orchymont). (D) Barranquilla, Colombia.

Diagnosis. – Adults are easily confused with those of *O. pacificus* and *O. arenicolus*, having the arcuate anterior pronotal margin, separate pronotal foveae and pubescent metasternum in common. *O. sierrensis* adults differ in lighter color, presence of very small postocular emarginations and especially aedeagal form. The aedeagus resembles that of *O. californicus* and *O. costipennis* males, but externally *O. sierrensis* adults differ markedly from those two species of the *bisinuatus* Group.

Description. – Ovate, slightly convex (Fig. 97D). *Size:* Holotype 1.36 mm long, 0.64 mm wide. *Color:* Dorsum and venter dark brown; legs and palpi brown. *Head:* Length 0.26 mm; width 0.38 mm. Frons microreticulate, with moderate size punctures and fine hairs, surface shiny; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi moderately large; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with small punctures, microreticulations, and fine hairs. Labroclypeal suture straight. Labrum length 0.33 width; surface with fine punctures and fine, dense hairs; median emargination small, with upturned edge, emargination obscured in habitus view. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, moderately shining, with sparse, small punctures; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.34 mm; maximum width (near anterior 0.33) 0.50 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near anterior 0.20 of lateral depression, extended arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum arcuate, without crenulations in front of lateral fossulae and without excavation in front of each lateral depression; anterior angles acute. Lateral depressions flat, microreticulate, with

small hairs; margins moderately arcuate; pronotum moderately constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, punctures moderately small, separated by one-three times puncture diameter; interpunctal areas with extremely fine, irregular impressions; with fine, sparse hairs. Median groove moderately deep and wide, with uniform microreticulation; not extended to anterior and posterior margins. Anterior foveae small, rather shallow ovals, connected to median groove by depression with well developed punctation. Posterior foveae moderately large,oval, rather deep; posteromedial areas confluent with median groove; surface sculpture as in median groove. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 0.88 mm; maximum width (near midlength) 0.64 mm. Disc flat, dull, with six rows of punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; most punctures somewhat elongate; intervals flat, width equal puncture width; with irregular, finely impressed lines; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin slightly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.7:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 118C)(6 examined).

Variation. – Specimens from Calaveras County have the transverse depressions joining the pronotal foveae slightly less microreticulate than specimens from Fresno County.

Distribution. – (Figs. 99A,183). California, on the western slope of the Sierra Nevada mountains.

Etymology. – The adjectival name, *sierrensis*, refers to the geographical distribution.

The *borealis* Subgroup

The *borealis* subgroup is characterized by broadly confluent posterior foveae not separated by a well-defined median groove. Infrequently, as in *O. lineatus* adults, the anterior and posterior foveae of a side are united to form a sinuate line (Fig. 103A).

A trend is apparent toward development (or possibly loss) of an enlargement of the median portion of the aedeagus in lateral view. Males of four of the five species comprising the subgroup have this feature. The enlargement reaches its maximum expression in males of *O. kaszabi*, (Fig. 108A) but is quite evident in those of *O. borealis* (Fig. 110A), *O. uniformis* (Fig. 110D) and *O. lineatus*, especially in males of the northern morph (Fig. 108D).

This subgroup has a northern distribution for the most part, with two species, *O. kaszabi* and *O. marinus* being holarctic. *O. lineatus* is the only exception to the northerly restricted pattern, being the most widespread species in the subgenus (Western Hemisphere members), extending as far south as Colombia (Fig. 107).

6. *Ochthebius lineatus* LeConte
(Figs. 10C,98D-F,103A-F,104,107,108C,D,119A,184)

Ochthebius lineatus LeConte, 1852:211 (lectotype male in MCZ, here designated; type-locality: Colorado River, California, U.S.A.). – LeConte, 1855:361. – LeConte, 1878:379. – Horn, 1890:24. – Leech and Chandler, 1956:333. – Hatch, 1965:18.

Ochthebius milleri Hatch, 1965:18 (holotype male in UWA; type-locality: Sucker Creek Canyon, Malheur County, Oregon, U.S.A.; new synonomy).

LeConte's type-series includes three specimens, the second of which is without head and prothorax. The first specimen, a male, is lectotype. LeConte (1852) in the original description states that the specimen (s?) before him were from "Colorado". In his later paper (1855), however, he writes "Colorado River, California", which agrees with the gold disc affixed to the pin, his code for California. The specimen is light colored and quite metallic, as is typical of southern morphs of this species (see section on variation). Hatch's holotype has an aedeagus of

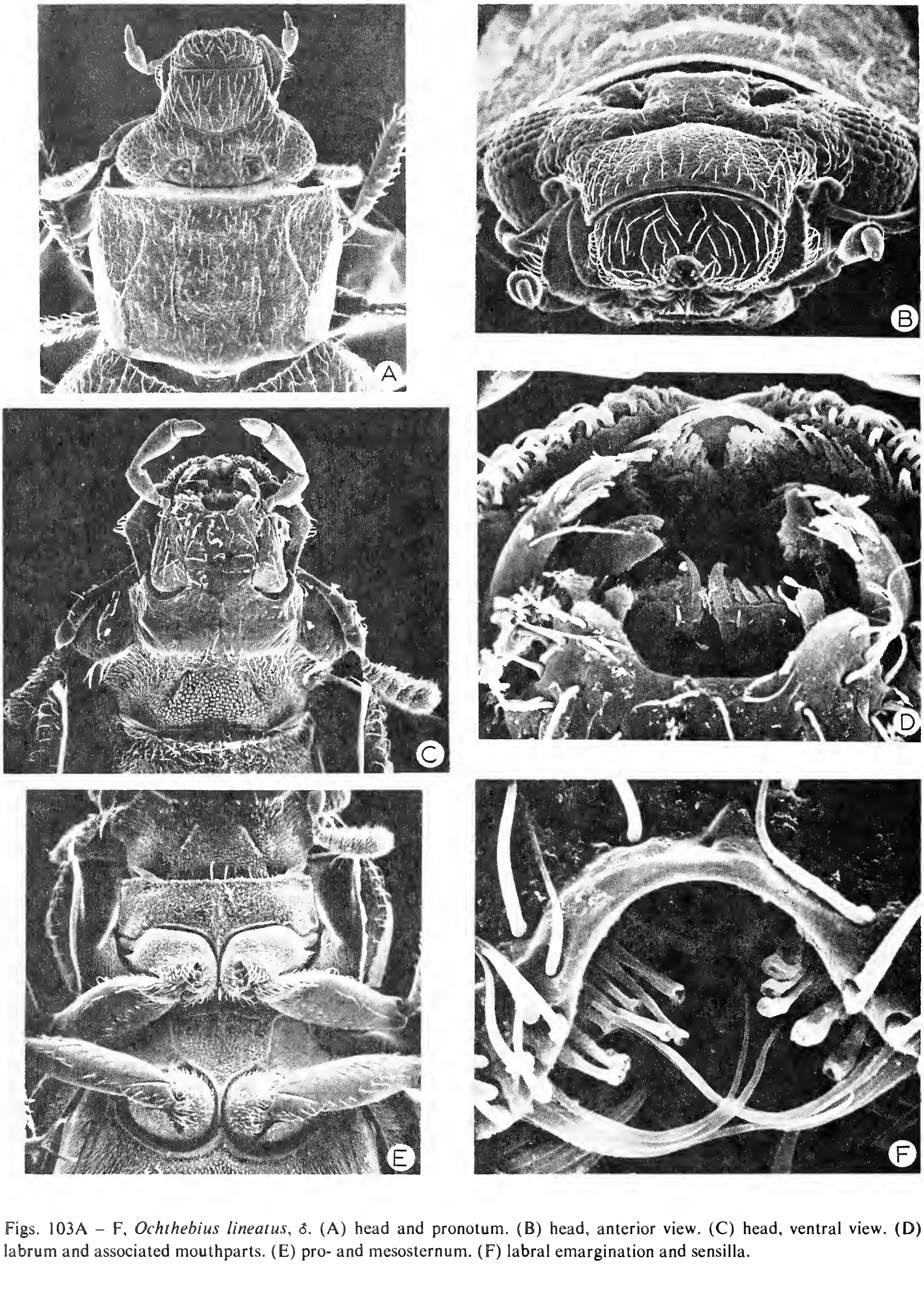
an intermediate type between that of the southern and northern morph (Fig. 104-apex of aedeagus from eastern Oregon was drawn from holotype of *O. milleri* Hatch).

Diagnosis. – Pronotal form (Fig. 103A) with lateral areas of anterior and posterior foveae of a side confluent to form a sinuate line and medial areas shallowly confluent to form a transverse depression at each end of the median groove, together with the long lateral depressions and glabrous area of the metasternum serve to distinguish adults of this species from others of *Ochthebius*

Description. – *Form:* Ovate, moderately convex (Fig. 119A). *Size:* Lectotype 1.48 mm long, 0.72 mm wide. *Color:* Head and pronotum brown; elytra, legs and venter slightly lighter. *Head:* Length 0.24 mm; width 0.40 mm. Frons finely sparsely punctate in middle region, sides microreticulate; with very fine hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi small but prominent; basomedial fovea small. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with microreticulation and fine hairs. Labroclypeal suture straight. Labrum length 0.33 width; surface with microreticulation and fine hairs; median emargination absent; anteromedial area upturned to produce a small tooth. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.66 length of 3. Mentum width equal length, shining, with small punctures; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.34 mm; maximum width (near anterior 0.33) 0.50 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapering to anterior angles. Lateral hyaline border origin near midlength of lateral depression, extended slightly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum arcuate, without crenulations in front of lateral fossulae and without, excavation in front of each lateral depression; anterior angles obtuse. Lateral depressions flat, microreticulate, sparsely, finely punctate, with small hairs; margins moderately arcuate; pronotum slightly constricted behind lateral depressions. Lateral fossulae shallowly impressed, with well developed microreticulation. Pronotal disc moderately convex, punctures in interfoveal area fine and sparse, separated by two-five times puncture diameter; with fine, sparse hairs; microreticulation extremely slightly developed; surface between punctures smooth and shiny. Median groove rather shallow, microreticulate. Anterior foveae with abrupt lateral margins, medial margins connected by moderately deep, microreticulate depression. Posterior foveae elongate, with abrupt lateral margins; posteromedial areas connected to median groove by shallow, microreticulate depression; raised lateral areas of anterior and posterior foveae together in form of sinuate line. Posterolateral angles with distinct impressions. Prosternum swollen in midline; coxae contiguous. Metasternal median glabrous area well developed. *Elytra:* Length 0.96 mm; maximum width (near midlength) 0.72 mm. Disc flat, moderately shiny, with six rows of punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; punctures round; intervals flat, width equal puncture width, with fine impressed lines; interstices between punctures 0.50 puncture length; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 2.0:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Figs. 104,108C,D)(140 examined); Female (Fig. 10C).

Variation. – This widely distributed species has a southern and northern geographical form (Fig. 107). The southern morph ranges from Colombia north through mainland Central America to approximately the Texas-Mexico border in the east, and the boundaries of the Great Basin in the West. Adults are typically smaller, lighter colored, many are testaceous with metallic reflections, and form of male genitalia is rather homogeneous throughout the range. The northern morph occurs in western North America from southern Canada south to the interface zone with the southern morph. Northern morph individuals are generally larger, dark brown colored, and males have an aedeagus differing from that of the southern morph (Figs. 104,108C,D). Variation in shape of the aedeagal apical piece is greater within the northern morph population suggesting considerable subpopulational isolation. This heterogeneity of aedeagal form in the northern morph results in a rather ill-defined interface zone between the two morphs. Consequently, there is no discrete "geographic morphological shift" composed of clinal intermediates between the two morphs. Therefore, I think the population relationships of *O. lineatus* are more accurately reflected by a discussion of "morphs", and not formal subspecific designation.

Natural History. – This species has a wide ecological tolerance; samples were collected at margins of streams, rivers, ponds (both permanent and temporary), lakes, swamps, and hot



Figs. 103A – F, *Ochthebius lineatus*, ♂. (A) head and pronotum. (B) head, anterior view. (C) head, ventral view. (D) labrum and associated mouthparts. (E) pro- and mesosternum. (F) labral emargination and sensilla.

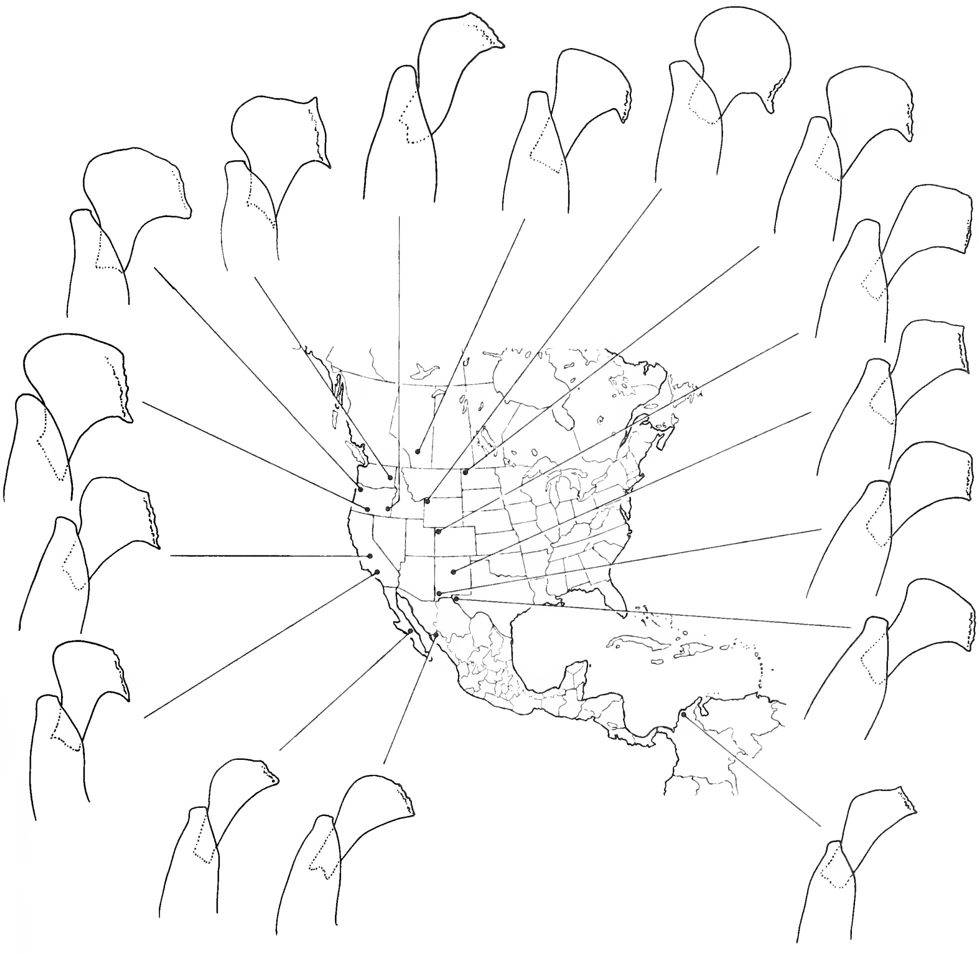


Fig. 104. Variation in the aedeagal apex of *Ochthebius lineatus.*

springs. More unusual habitat descriptors include "rock crevice, tidewater", "foul pool", "gravel pit", and "alkalia water".

Distribution. – Western North America, mainland Central america, and northern South America (Figs. 107,184).

Remarks. – *O. lineatus* is the most frequently collected North American *Ochthebius*. I have examined 1,690 specimens (see appendix).

7. *Ochthebius marinus* (Paykull)
(Figs. 105A,106A,B,108B,109,111H,184)

Elophorus marinus Paykull, 1798:245 (type depository undetermined). – d'Orchymont, 1943a:12. – F. Balfour-Browne, 1958:163. – Janssens, 1967b:54.

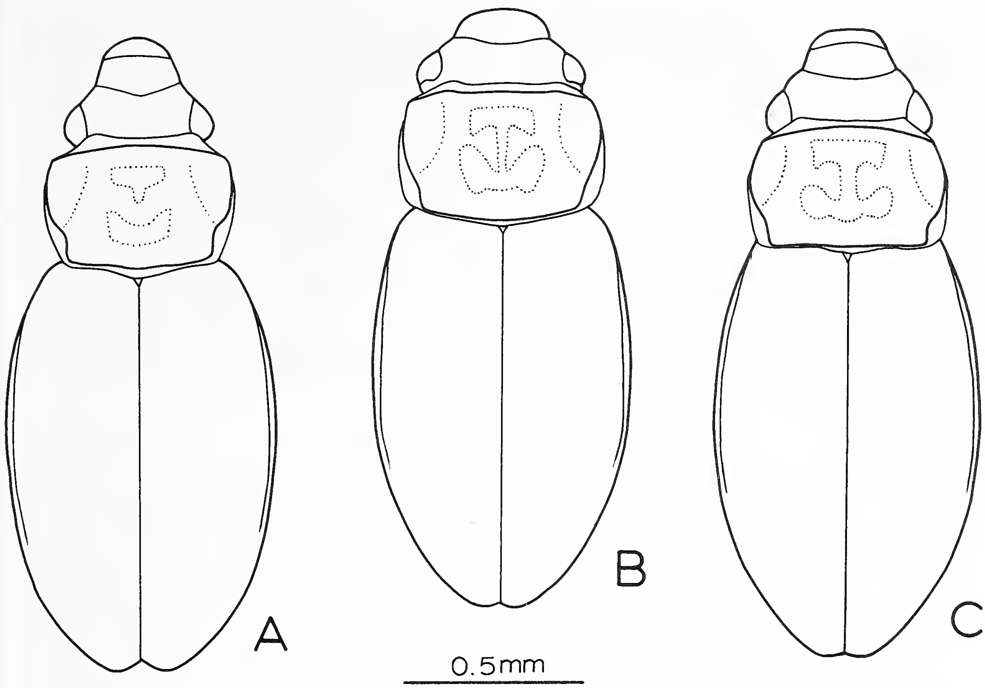
Ochthebius holmbergi Mäklin, 1852:74 (lectotype male in MCZ, here designated; type-locality: Kenai Peninsula, Alaska, U.S.A.; new synonomy). – LeConte, 1855:362. – LeConte, 1878:379. – Horn, 1890:24. – Leech and Chandler, 1956:333. – Hatch, 1965:18.

Depository of the holotype of *O. marinus* is unknown. My concept is based upon specimens in the Institut royal des Sciences Naturelles de Belgique (Brussels) and in the British Museum (Natural History) (London) determined by A. d'Orchymont and J. Balfour-Browne, respectively. The aedeagi of these males have been removed and studied; they are clearly of the form illustrated by d'Orchymont (1943a, p.14) for *O. marinus*. Further research is necessary to find the holotype of this species.

The type-series of *Ochthebius holmbergi* Mäklin in the LeConte collection at the MCZ consists of six specimens. The first is a male which has been dissected to remove the aedeagus; it is clearly of the *O. marinus* form. This specimen is lectotype of *O. holmbergi*. LeConte had informed Alexander Agassiz of the MCZ in a letter (Darlington, 1961) that part of his collection, which he was donating, contained specimens from Mäklin's collection. For this reason I feel the specimen here selected as lectotype, which is from the type-locality (Kenai Peninsula), was one of the syntypes before Mäklin at the time of his original description.

Diagnosis. – Certain individuals of this species are externally very similar to *O. kaszabi*, but are distinguished by the metasternum which is glabrous in at least the posterior 0.50 of the median area in *O. marinus* and totally hydrofuge pubescent or glabrous in the extreme posterior 0.20 in *O. kaszabi*. Additionally, most *O. kaszabi* adults have the elytral intervals more elevated and the pronotum more deeply sculptured (Figs. 106A-D). The extremely dissimilar male genitalia (Figs. 108A,B) provide the most reliable means of separation. Refer to the sections on variation for further comment.

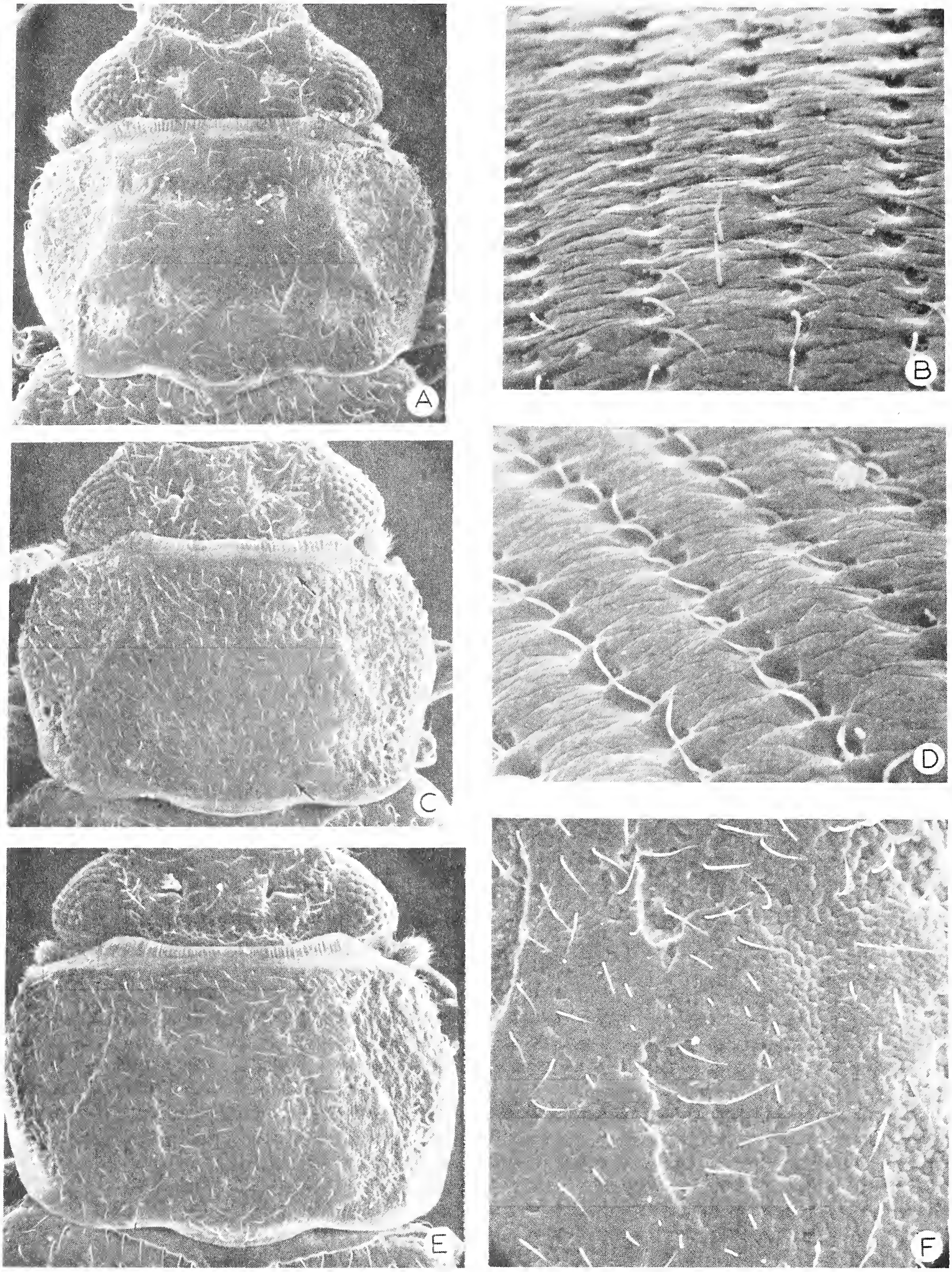
Description. – *Form:* Elongate-oval, moderately convex (Fig. 105A). *Size:* Approximately 1.84 mm long, 0.80 mm wide. *Color:* Dorsum dark brown, venter slightly darker; palpi and elytral epipleura slightly lighter. *Head:* Length 0.32 mm; width 0.46 mm. Frons slightly elevated in midline, with microreticulation, punctures twice size of microreticulation, microreticulation nearly absent from elevated midregion, but well developed anterior to elevation; surface shiny, with very fine hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi moderately large; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; microreticulation and punctures as on frons, with fine hairs. Labroclypeal suture straight. Labrum length slightly less than 0.33 width; surface with microreticulation and fine, moderately dense hairs; median emargination absent, entire anterior margin very slightly arcuate to posterior. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, moderately shining, with sparse, small punctures; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.42 mm; maximum width (near anterior 0.33) 0.60 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near midlength of lateral depression, extended straight to



Figs. 105A – C, *Ochthebius* body outlines. (A) *O. marinus.* (B) *O. uniformis.* (C) *O. kaszabi.*

posterior angles, very narrow around posterior margin. Anterior margin of pronotum arcuate, without crenulations in front of lateral fossulae and without excavation in front of each lateral depression; anterior angles obtuse. Lateral depressions long, 0.75 length of pronotum, flat in anterior 0.50, slightly convex in posterior 0.50; microreticulate and punctate, with small hairs; margins arcuate; pronotum slightly constricted behind lateral depressions. Lateral fossulae deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, punctures small and sparse, separated by three-six times puncture diameter; with fine, sparse hairs; surface between punctures smooth and shiny. Median groove absent from posterior 0.50, anterior 0.50 united to confluent anterior foveae as deeply impressed T-shape, interior with well developed microreticulation. Posterior foveae with abrupt lateral margins; posteromedial areas confluent; together the confluent foveae in form of deeply impressed, broad U-shape, interior microreticulate. Posterolateral angles with with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.20 mm; maximum width (near midlength) 0.80 mm. Disc flat, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; most punctures quite small, round and closely set; intervals slightly rounded, width equal puncture width; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin weakly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 2.0:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 108B)(41 examined).

Variation. – Coloration of many adults is very distinctive: head and pronotum are dark brownish, frequently with bluish reflections, which contrast with the testaceous elytra, palpi and legs. Some specimens, however, are primarily brown without these attractive contrasting color differences. The area between median groove and confluent posterior foveae varies considerably, from very broad, equaling length of the median groove, to very narrow. Some



Figs. 106A – F, *Ochthebius* structures. (A) *O. marinus*, pronotum. (B) *O. marinus*, elytral striae and intervals. (C) *O. kaszabi*, pronotum (arrows indicate pronotal sensilla). (D) *O. kaszabi*, elytral striae and intervals. (E) *O. borealis*, pronotum. (F) *O. borealis*, pronotal microsculpture.

specimens with the very narrow condition have a slight depression joining the median groove to the confluent posterior foveae; however, the microreticulation of the groove and that of the foveae are not contiguous. The glabrous area of the metasternum occupies approximately the posterior 0.50 of the metasternum, although some specimens have a number of hairs within the otherwise glabrous area. This latter condition appears in specimens from various localities and no discrete geographical trends were observed. I have examined 702 specimens (see appendix).

Natural History. – Judging from locality data (see appendix) it appears that *O. marinus* is primarily a pond species with some halophilous tendencies.

Distribution. – (Figs. 109,184). Western North America: southern limits are the southern areas of California, Nevada, Utah and Colorado; northern limits are Churchill, Manitoba in the east and Kenai Peninsula, Alaska in the west.

8. *Ochthebius uniformis* new species
(Figs. 105B,110D,117C,184)

Type-locality. – San Francisco, California, U.S.A.

Type-specimens. – The holotype male and allotype, which have identical locality data, are deposited in CAS. They were collected by F.E. Blaisdell in 1909. Data about paratypes (80) are presented in the appendix.

Diagnosis. – The following combination of characteristics renders this species quite distinct from the other members of the *borealis* Subgroup: 1) black color, 2) somewhat convex form, with moderately deflexed head, 3) oval posterior foveae, lacking abrupt lateral extremes and, 4) extremely uniform microreticulation of pronotal foveae and lateral areas.

Description. – *Form:* Ovate, moderately convex (Fig. 105B). *Size:* Holotype 1.76 mm long, 0.80 mm wide. *Color:* Dorsum and venter very dark brown, nearly black; legs and palpi brown. *Head:* Length 0.30 mm; width 0.46 mm. Frons slightly elevated and very shiny in midline; microreticulatate and punctate, punctures five times size of microreticulation pattern; microreticulation absent from elevated midregion, but well developed anterior to elevation and in lateral areas; with fine, sparse hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with microreticulation in posterior 0.50, anterior 0.50 shiny, with sparse, fine punctures; with fine hairs. Labroclypeal suture straight. Labrum length 0.33 width; surface with microreticulation and fine, moderately dense hairs; median emargination absent, entire anterior margin slightly arcuate to rear, with very slightly elevated edge in midline. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, with sparse, small punctures; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.42 mm; maximum width (near anterior 0.33) 0.60 mm. Anterior hyaline border rather narrow in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near anterior 0.33 of lateral depression, extended slightly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum arcuate, without crenulations in front of lateral fossulae and without excavation in front of each lateral depression; anterior angles obtuse. Lateral depressions flat, broad and long, extended 0.80 length of pronotum; with distinctive microreticulation and very sparse small hairs; very small tooth at posterior extreme; margins arcuate, pronotum very slightly constricted behind. Lateral fossulae shallowly impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, punctures moderately small, separated by one-three times puncture diameter; with fine, sparse hairs; surface between punctures smooth and shiny. Median groove in middle 0.25 of pronotum only, very shallow, microreticulate; anterior and posterior extremes obliterated by markedly confluent foveae. Anterior foveae broadly and deeply confluent, united to median groove in form of T, microreticulate. Posterior foveae broadly oval, with lateral and anterior 0.50 of medial margins equally abrupt; posteromedial areas broadly confluent; entire depressed area distintly microreticulate. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with well developed median glabrous area. *Elytra:* Length 1.16 mm; maximum width (near midlength) 0.80 mm. Disc flat, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; most punctures round, small; intervals rounded, width equal puncture width, with fine impressed lines; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and

slender; ratio of hind leg length to abdominal length 1.8:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 110D)(25 examined).

Variation. – The connection between the median groove and posterior foveae, as indicated by contiguity of microreticulation of the respective areas, is evident in all specimens. The metasternal glabrous area is well developed, occupying at least the posterior 0.50 of the metasternum.

Natural History. – Adults have been collected in many coastal ponds. H.B. Leech collected a specimen from "Dillon Beach, pools, foot of Sand Point Dunes". Other collectors reported "pond near beach" (542 specimens), "Whale Beach", "Point Reyes Peninsula ", "Siltcoos Beach" and other descriptors indicating halophilic habits (see appendix).

Distribution. – (Figs. 117C,184). Coastal ponds of Washington, Oregon and California. One inland locality known: Fish Lake, Steens mountains, eastern Oregon (B. Malkin).

Etymology. – Latin, *unus* (one) plus *formus* (form). Named in reference to the uniform microreticulation of the pronotum.

9. *Ochthebius borealis* new species
(Figs. 97F,106E,F,110A-C,111D-F,117C,184)

Type-locality. – Pool in stream, grassy slope, 4.5 miles S. of Mendocino Pass, 6500 feet, NW corner Glenn County, California, U.S.A.

Type-specimens. – The holotype male and allotype are deposited in CAS and have identical locality data. They were collected by Hugh B. Leech, July 29, 1960. Data about paratypes (362) are presented in the appendix.

Diagnosis. – Within the *borealis* Subgroup, *O. borealis* adults are distinguished by abrupt, elevated lateral extremes of the posterior foveae (Figs. 106E,F), black color and aedeagal form.

Description. – *Form:* Ovate, moderately convex (Fig. 97F). *Size:* Holotype 2.00 mm long, 0.80 mm wide. *Color:* Dorsum and venter black; legs and palpi dark brown. *Head:* Length 0.36 mm; width 0.50 mm. Frons microreticulate, with moderately small punctures, surface shiny; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; microreticulation very uniform and hairs fine, very sparse. Labroclypeal suture straight. Labrum length 0.33 width; microreticulate, punctures moderately small; hairs fine, dense; median emargination absent, entire anterior margin slightly arcuate to rear and very slightly upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 nearly 0.66 length of 3. Mentum width equal length, moderately shining, microreticulate with randomly spaced punctures about equal in size to four microreticulation elements: anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (near anterior 0.33) 0.70 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near midlength of lateral depression, extended slightly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum arcuate, without crenulations in front of each lateral depression; anterior angles obtuse. Lateral depressions flat, broad and long, extended across 0.75 length of pronotum; small tooth at posterior extreme; with distinctive microreticulation and very sparse, small hairs; margins arcuate; pronotum slightly constricted behind lateral depressions. Lateral fossulae rather shallowly impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into tooth at lateral hyaline border. Pronotàl disc slightly convex, interfoveal areas with very uniform microreticulation and very sparse, fine hairs; surface dull. Median groove shallow depression connected with markedly confluent anterior and posterior foveae, microreticulate. Anterior foveae broadly confluent, with ditinctive microreticulation; lateral margin of each fovea delimited by oblique carina. Posterior foveae with lateral margins abrupt, straight, oblique lines; posteromedial areas broadly confluent; entire depression with microreticulation. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with well developed median glabrous area. *Elytra:* Length 1.28 mm; maximum width (near midlength) 0.88 mm. Disc flat, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; most punctures round; intervals rounded, width equal puncture width; with fine impressed lines; interstices between punctures 0.50 puncture length; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short

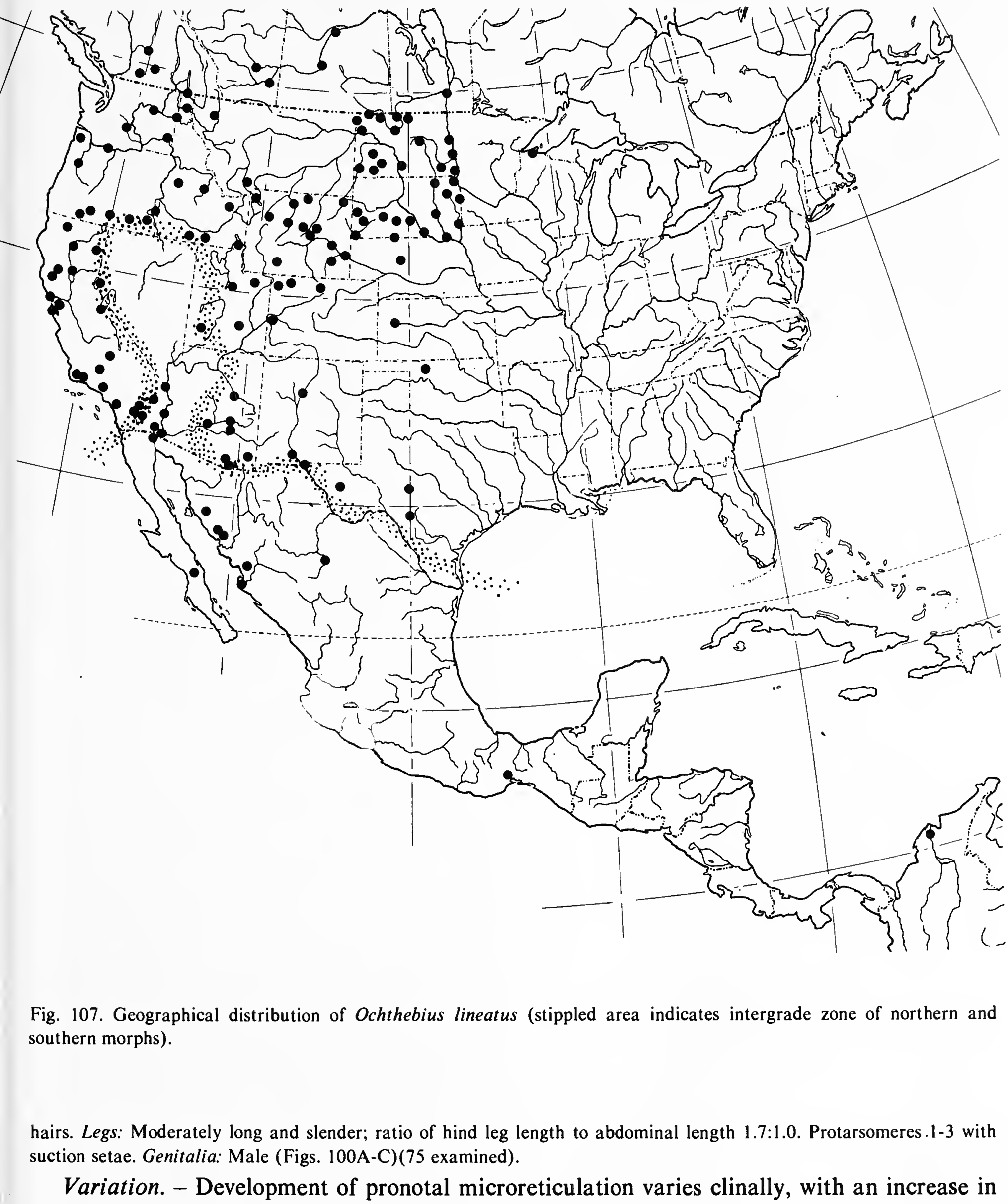
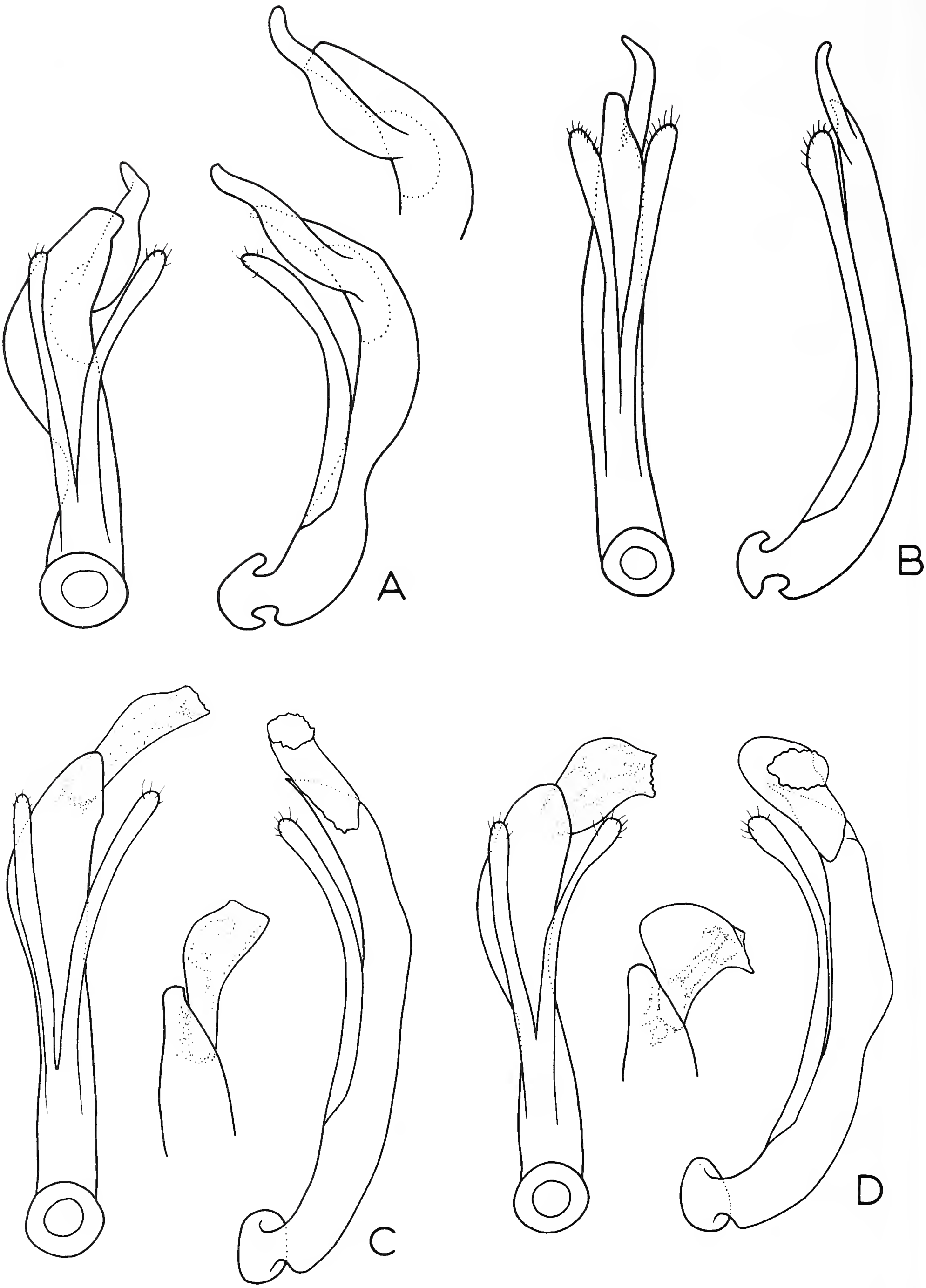


Fig. 107. Geographical distribution of *Ochthebius lineatus* (stippled area indicates intergrade zone of northern and southern morphs).

hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.7:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Figs. 100A-C)(75 examined).

Variation. – Development of pronotal microreticulation varies clinally, with an increase in microreticulation from north to south. Related to decrease in microreticulation of northern specimens is reduction in development of the median groove. The latter connects broadly with the confluent posterior foveae in specimens from Baja California, and the microreticulation of the two depressions is contiguous. This condition is lessened somewhat in specimens from northern California, although microreticulation of the median groove and posterior foveae is contiguous. Specimens from British Columbia, however, have the median groove separated from the confluent posterior foveae, and microreticulation of the two areas lack contiguity.

There are corresponding differences in genitalia of specimens from the three areas (Figs. 110A-C). Those of the southern form appear to be more similar to the central form than



Figs. 108A – D, Aedeagi of *Ochthebius* species. (A) *O. kaszabi*, Yukon Territory, Canada. (B) *O. marinus*, Bottineau County, North Dakota, (C) *O. lineatus*, Riverside County, California. (D) *O. lineatus*, Cassia County, Idaho. (insets: apices rotated slightly)

the latter is to the northern form. This similarity may indicate a greater rate of gene flow between the central and southern populations. However, this may be a reflection of inadequate sampling in the areas between the central and northern populations. In either event, based upon the genitalic differences between other species, I have no doubt that the northern form is conspecific with the central and southern forms. The male labrum also displays clinal variation, with members of most southern populations having the anterior border upturned along its entire width (Fig. 111E); the central populations with generally only the middle region slightly upturned; and the northern populations very slightly upturned in the middle region, or not at all. All specimens of *O. borealis* have the glabrous metasternal area well developed, occupying at least the posterior 0.50 of the metasternum.

Natural History. – Locality data indicate that *O. borealis* members live in both ponds and streams, but not in halophilic situations.

Distribution. – (Figs. 117C,184). Western North America; eastern and southern limits roughly formed by a line drawn through British Columbia, Colorado and Baja California.

Etymology. – Latin, *borealis* (northern). I refer to the geographical distribution.

10. *Ochthebius kaszabi* Janssens
(Figs. 92A,105C,106C,D,108A,111G,184)

Ochthebius kaszabi Janssens, 1967b:56 (holotype male deposited in HNHM; type-locality: Mongolia, Bajachongor aimak, Tujn gol, 1250 m., bei somon Bogd).

Dr. Z. Kaszab of the Hungarian Natural Histroy Museum, Budapest, loaned me the putative holotype of *O. kaszabi*. However, data on labels attached to the specimen do not correspond to any of that given by Janssens (1967b) for *O. kaszabi*. The specimen has five labels as follows (diagonal lines indicate different labels): /Mongolia, Bajanchongor aimak, Tujn gol, 1250 m. bei somon Bodg Exp. Dr. Z. KASZAB, 1964/Nr. 195 25-VI-1964/ Prep. Micr. No. 816511/ TYPE (red label)/ E. Janssens det., 1965, *Ochthebius* sensu stricto *kaszabi* n. sp./. Janssens (1967b), however, cites this locality in data for *O. marinus*, *O. evanescens* and *O. mongolicus* (and it is certainly possible that all four species were collected at a single locality).

Furthermore, the aedeagus on microslide which bears the preparation number corresponding to that on the label attached to the holotype ("Prep. Micr. No. 816511") is the aedeagus of *O. subaeneus* Janssens (1967b), and is indicated as such on the microslide label (this microslide is deposited in HNHM). Dr. Kaszab informs me (*in litt.*) that this microslide plus one additional microslide (which I have seen – it has also the aedeagus of *O. subaeneus)* arc the only microslides available in the Hungarian Museum collection.

In a 1978 visit to the Institut royal des Sciences de Belgique, I searched for additional microslides with aedeagi which corresponded to that illustrated by Janssens (1967b) for *O. kaszabi*, and located two such slide-mounted aedeagi.

Amongst this confusion one point remains paramount: the aedeagus of *O. kaszabi* illustrated by Janssens is unique and quite distinctive. To resolve this confusion, I removed the coverslip of one of the microslide mounts which has an *O. kaszabi* aedeagus, and placed this aedeagus in a microvial and attached same to the pin bearing the holotype. This may or may not be the aedeagus of the holotype, but it is certainly the aedeagus of an *O. kaszabi* specimen from Mongolia; it differs only very slightly from aedeagi of specimens of *O. kaszabi* from North America.

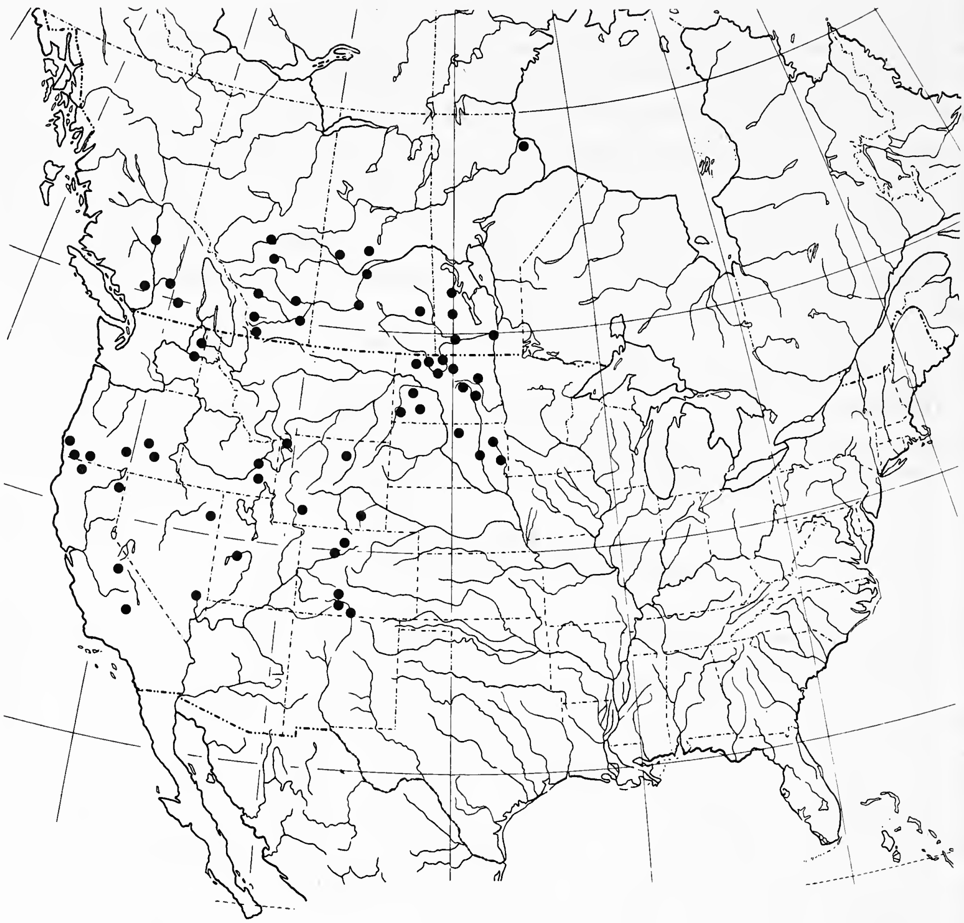
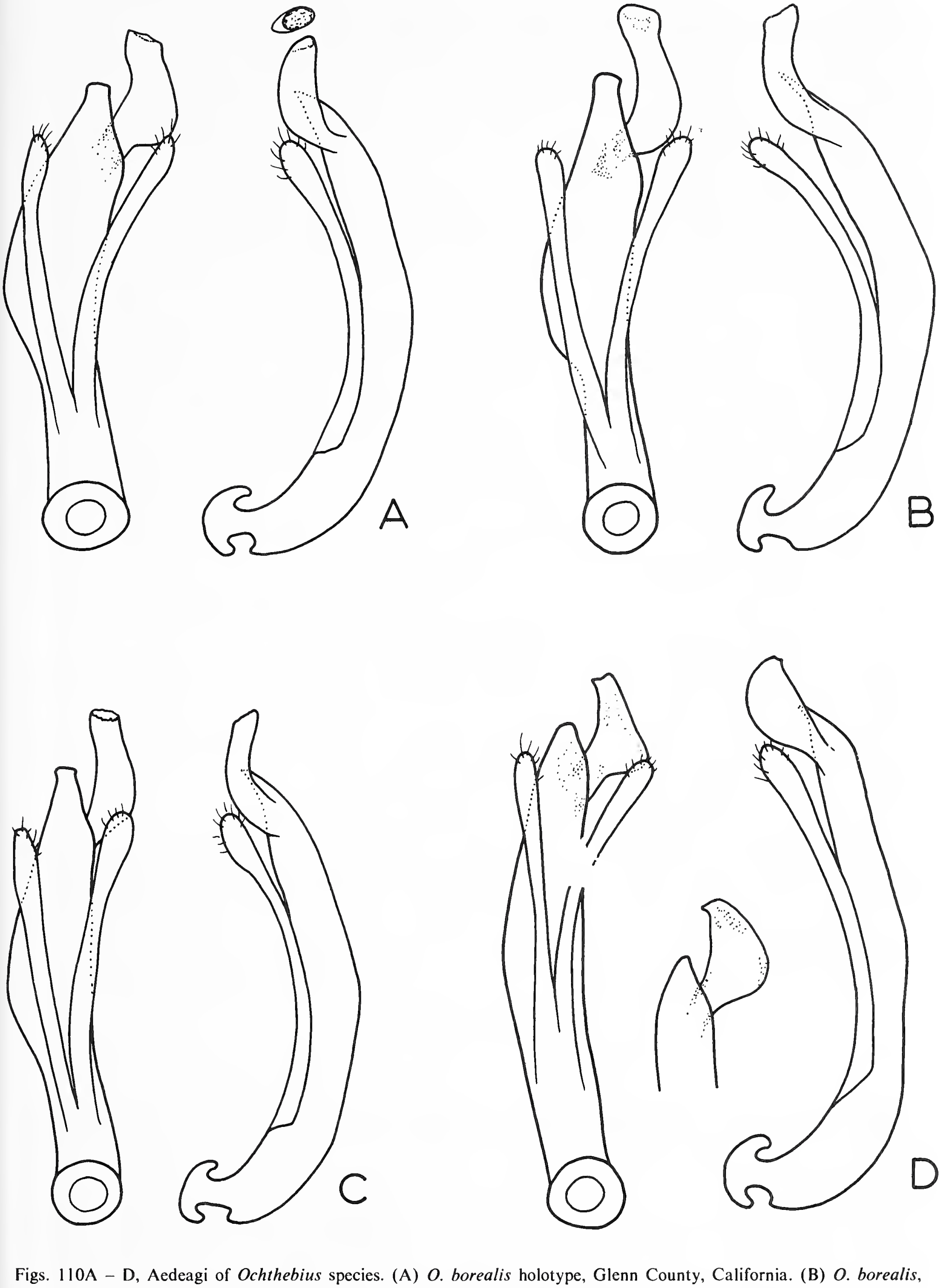


Fig. 109. Geographical distribution of *Ochthebius marinus* (Kenai Peninsula, Alaska, locality omitted).

Diagnosis. – Refer to the diagnosis of *O. marinus* and to the variation discussions of both species.

Description. – *Form:* Elongate-oval, moderately convex (Fig. 105C). *Size:* Length 1.80 mm; width 0.44 mm. *Color:* Dorsum and venter dark brown; legs and palpi brown. *Head:* Length 0.30 mm; width 0.44 mm. Frons slightly elevated, with microreticulation within punctures; latter dense, some confluent; with very fine hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial fovea nearly as deep and as large as interocular foveae. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with microreticulation and fine hairs. Labroclypeal suture straight. Labrum length 0.33 width; surface with microreticulation and fine hairs; median emargination absent, entire margin slightly arcuate to rear. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, with microreticulation and small punctures; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near anterior 0.33) 0.60 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near midlength of lateral depression, extended straight to posterior angles, very narrow around posterior margin. Anterior margin of pronotum arcuate, without crenulations in front of lateral fossulae and without excavation in front of each lateral depression; anterior angles obtuse. Lateral depressions flat, broad and long, extended across 0.75 length of pronotum, with microreticulation, irregular punctures, and small hairs; margins moderately arcuate; pronotum slightly constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, with well



Figs. 110A – D, Aedeagi of *Ochthebius* species. (A) *O. borealis* holotype, Glenn County, California. (B) *O. borealis*, British Columbia, Canada. (C) *O. borealis*, Baja California, Mexico. (D) *O. uniformis*, holotype (inset: apex rotated slightly).

developed microreticulation; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, punctures in interfoveal area moderately small, separated by one-three times puncture diameter; with fine, sparse hairs; surface between punctures smooth and shiny. Median groove confluent in anterior 0.50 with deeply confluent anterior fovea in form of T-shaped depression with well developed microreticulation; posterior 0.50 of median groove absent, posterior foveae deeply confluent. Latter with abrupt lateral margins; posteromedial areas broadly confluent with median groove in form of wide U-shaped depression with well developed microreticulation. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 1.20 mm; maximum width (near midlength) 0.80 mm. Disc flat, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity beginning near posterior 0.33; punctures round; intervals rounded, moderately elevated, width equal puncture width, with fine impressed lines; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin slightly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.7:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 108A)(37 examined).

Variation. – The connection between the median groove and confluent posterior foveae, as indicated by the contiguity of the microreticulation of the two areas, varies from moderately developed to entirely absent, although the former condition predominated in the specimens studied. Extremes occur within single series, illustrating that this condition is unrelated to geographic considerations. Range of variation in development of the pronotal median groove makes it virtually impossible to distinguish certain specimens of *O. marinus* and *O. kaszabi* on the basis of these features. The metasternum of *O. kaszabi* adults is either entirely pubescent, or only the posterior 0.20 is glabrous. The glabrous metasternal area of *O. marinus* adults occupies at least the posterior 0.50 of the metasternum. This character plus moderately elevated elytral intervals of *O. kaszabi* and flat intervals of *O. marinus* (Figs. 106B,D) serve to distinguish the two species, as do the male genitalia (Figs. 108A,B).

A long series of specimens from Churchill, Manitoba (10-VIII-1937, W.J. Brown collector) contained both *O. kaszabi* and *O. marinus*. Adults of both species were at their character extremes, thus it was quite easy to distinguish one group from the other on the basis of pronotal, elytral, color and size differences in addition to genitalic features. Perhaps this indicates some degree of character displacement acting upon these two species.

I have studied a total of 286 specimens of *O. kaszabi* (see appendix).

Natural History. – Most of the locality data for this species do not specify lotic or lentic habitats, although a few "lake", "pond" and "spring" citations are present (see appendix). I have collected *O. kaszabi* adults from the sand-gravel margin of a moderately rapid stream in British Columbia.

Distribution. – (Figs. 92A,184). Mongolia and northern North America.

The *rectus* Subgroup

Shape of the lateral pronotal depressions, which are nearly parallel to one another anteriorly and are markedly arcuate posteriorly (Fig. 96A), serves to characterize the three members of this subgoup.

This subgroup lives in western United States, with one species (*O. rectus*) widely distributed, one (*O. rectusalsus*) restricted to saline coastal areas, and one (*O. recticulus*) restricted to the Wilbur Hot Springs area of Colusa County, California.

Habitat data indicate that members of this group are facultative halophiles.

11. *Ochthebius rectus* LeConte
(Figs. 96A,101D,111A-C,112E,113A,B,182A)

Ochthebius rectus LeConte, 1878:379 (holotype female in MCZ; type-locality: Fort Tejon, Kern County, California, U.S.A.). – Horn, 1890:21. – Fall, 1901:213. – Fall, 1919:212. – Brown, 1933:45. – Leech and Chandler, 1956:333. – Hatch, 1965:19.

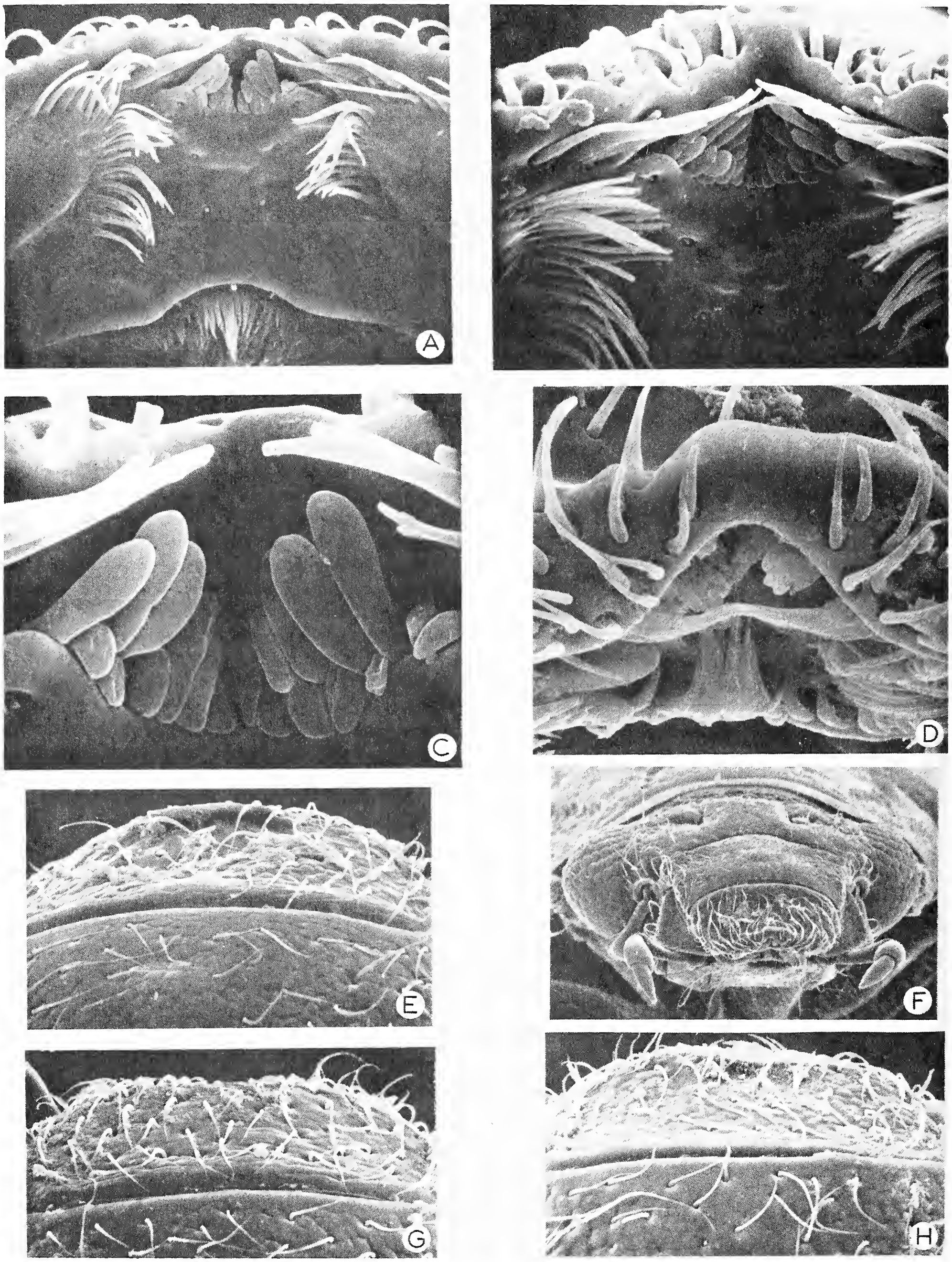
Diagnosis. – Form of the lateral pronotal depressions, which are parallel anteriorly and markedly arcuate posteriorly, broad lateral hyaline borders extended to the anterior angles, and the oblong body form (Figs. 96A,112E) serve as diagnostic characteristics for *O. rectus*. Refer to the diagnoses of *O. recticulus* and *O. rectusalsus* for a comparison with those species.

Description. – *Form:* Oblong, slightly depressed (Fig. 112E). *Size:* Holotype 2.12 mm long, 0.96 mm wide. *Color:* Dorsum and venter black; legs and palpi dark brown. *Head:* Length 0.34 mm; width 0.52 mm. Frons slightly elevated, finely, moderately densely punctate, slightly microreticulate laterally; interocular foveae deep and large, width of each equal to distance between them; interocular tuberculi large; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with dense, fine punctures and fine sparse hairs. Labroclypeal suture straight. Labrum length 0.33 width; surface with microreticulation and fine hairs; median emargination absent, entire margin slightly arcuate to rear. Maxillary palpus with palpomere 3 moderately wide; palpomere 4, 0.50 length of 3. Mentum width equal length, shining, with microreticulation and small punctures; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.48 mm; maximum width (near anterior 0.33) 0.76 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border broad, origin at anterior angles, extended arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum very slightly bisinuate, without crenulations in front of lateral fossulae and without excavation in front of each lateral depression; anterior angles acute. Lateral depressions convex, broad and long, extended 0.75 length of pronotum, with microreticulation, irregular punctures, and small hairs; margins arcuate, rounded at posterior, not excavate; pronotum constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapering into lateral hyaline border. Pronotal disc moderately convex, punctures in interfoveal area moderately small and dense, separated by 0.5-1.0 times puncture diameter; with fine, sparse hairs; surface between punctures smooth and shiny. Median groove narrow channel with microreticulation. Anterior foveae well developed, width equal to distance between each fovea from median groove; internally microreticulate. Posterior foveae well developed, oblique, with well developed microreticulation. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 1.46 mm; maximum width (near midlength) 0.96 mm. Disc slightly convex, moderately shiny, with six rows of round punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; intervals rounded, very slightly elevated, width 0.50 puncture width; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin slightly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.8:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Figs. 113A,B)(53 examined).

Variation. – Specimens studied range in length from 1.60 to 2.20 mm. The aedeagus varies as illustrated (Figs. 113A,B); no significant external variation was noted which correlated with these genitalic variants. A total of 453 specimens were examined (see appendix).

Natural History. – Locality data indicate that *O. rectus* is halophilic and thermophilic, with many specimens taken at the saline margins of desert hot springs. Habitat descriptors include "at edge of hot spring", "small waterhole on alkaline flat", "Salt Creek", "salt marsh", "Badwater, Death Valley", "Saratoga Spring, Death Valley", "saline pool", "alkaline irrigation ditch", and "muck, hot spring temp. 90 degrees F.".

Distribution. – (Figs. 101D,182A). Western North America; from Vancouver Island, British Columbia south to southern Califormia and east to Wyoming. Greatest population density in the arid regions of California.



Figs. 111A – H, *Ochthebius* structures. (A) *O. rectus* ♀, ventral surface of labrum. (B) *O. rectus* ♂, ventral surface of labrum. (C) *O. rectus* ♀, labral sensilla. (D) *O. borealis* ♂, labral emargination. (E) *O. borealis* ♂, labrum, dorsal aspect. (F) *O. borealis* ♂, anterior aspect of head. (G) *O. kaszabi* ♂, labrum, dorsal aspect. (H) *O. marinus* ♂, labrum, dorsal aspect.

12. *Ochthebius rectusalsus* new species
(Figs. 101E,112F,114A,182A)

Type-locality. – Tide pool, Albany, Contra Costa County, California, U.S.A.

Type-specimens. – Holotype male and allotype with identical locality data are in CAS. These specimens were collected by C.T. Dodds, February 8, 1921. Data about paratypes (52) are presented in the appendix.

Diagnosis. – The broader form, coarser pronotal punctation, denser pronotal pubescence, brown color and aedeagal form serve to distinguish adults of this species from those of the very similar *O. rectus* (Figs. 112E,F,113B,114A).

Description. – *Form:* Ovate, moderately convex (Fig. 112F). *Size:* Holotype 1.80 mm long, 0.82 mm wide. *Color:* Dorsum and venter dark brown; legs and palpi brown. *Head:* Length 0.32 mm; width 0.46 mm. Frons slightly elevated, coarsely densely punctate, some microreticulation evident anteriorly and laterally, sparsely pubescent; interocular foveae deep and large, width of each equal to distance between them; interocular tuberculi large; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, densely coarsely punctate, sparsely pubescent. Labroclypeal suture straight. Labrum length 0.33 width; surface with microreticulation and fine hairs; median emargination absent, entire margin slightly arcuate to rear. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, with microreticulation and small punctures; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (near anterior 0.33) 0.70 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border broad, origin at anterior angles, extended very arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum straight, with small crenulations in front of lateral fossulae; without excavation in front of each lateral depression; anterior angles right. Lateral depressions convex, broad and long, extended across 0.75 length of pronotum, microreticulation within punctures, punctures coarse, dense; pubescence sparse; margins arcuate, evenly rounded at posterior, not excavate; pronotum constricted behind lateral depressions. Lateral fossulae deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, quite hairy; punctures in interfoveal area coarse, dense, microreticulate, separated by 0.50 puncture diameter; with prominent, dense hairs; ridges between punctures smooth and shiny. Median groove narrow, deeply impressed, internally microreticulate, impunctate. Anterior foveae obscured by dense, coarse punctures, this area shallowly depressed. Posterior foveae moderately deep, with dense, coarse punctures. Posterolateral angles with distinct impressions. Prosternum with low ridge ended at coxal cavities; coxae contiguous. Metasternum with very small median glabrous area anterior to hind coxae. *Elytra:* Length 1.24 mm; maximum width (near midlength) 0.82 mm. Disc convex, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity beginning near posterior 0.33; punctures round, intervals rounded, very slightly elevated, width 0.50 puncture width; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin slightly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.9:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 114A)(18 examined).

Variation. – No significant differences were noted in the specimens studied.

Natural History. – This species is halophilic, as indicated by the following habitat descriptors: “tide pool”, “mud, salt flat”, “salt marsh”, “Moss Landing”, and “salt ponds”. Among Western Hemisphere Hydraenidae, only *Neochthebius vandykei* is definitely known to be intertidal. Further study may indicate that *O. rectusalsus* is also capable of maintaining populations in habitats which are submerged at high tide.

Distribution. – (Figs. 101E,182A). Coastal, from San Francisco bay area, California, south to Baja California, Mexico. One specimen known from the coast of Washington.

Etymology. – *rectus* plus Latin *salsus* (salted). Named in reference to the halophilic habits and external similarity to *O. rectus.*

13. *Ochthebius recticulus* new species
(Figs. 101E,112D,113C,182A)

Type-locality. – Wilbur Springs, elevation 1250 feet, Colusa County, California, U.S.A.

Type-specimens. – The holotype and allotype with identical locality data are in USNM. I collected these specimens July 17, 1971. Data about paratypes (143) are presented in the appendix.

Diagnosis. – Small size, limited distribution and male genitalia (Figs. 112D,113C) serve to distinguish *O. recticulus* adults from those of its closest relatives, *O. rectusalsus* and *O. rectus.*

Description. – *Form:* Elongate-oval, moderately depressed (Fig. 112D). *Size:* Holotype 1.56 mm long, 0.72 mm wide. *Color:* Dorsum black; venter, legs and palpi dark brown. *Head:* Length 0.26 mm; width 0.40 mm. Frons with dense, large punctures, some confluent; microreticulation moderately developed laterally, less so medially; hairs well developed; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial fovea nearly as deep and as large as interocular foveae. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with well developed microreticulation and fine hairs. Labroclypeal suture straight. Labrum length 0.33 width; surface with microreticulation and fine hairs; median emargination absent. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, with microreticulation and small punctures; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near anterior 0.33) 0.58 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin at anterior angles, extended very arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum straight, with small crenulations in front of lateral fossulae; without excavation in front of each lateral depression; anterior angles acute. Lateral depressions convex, broad, with large dense punctures and well developed hairs; margins arcuate; pronotum quite constricted behind lateral depressions. Lateral fossulae deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, punctures large, deep and dense, in some specimens confluent and with internal microreticulation; form of foveae partially obscured by large size and density of punctures; hairs well developed. Median groove slightly developed in anterior and posterior; middle region obscured by large punctures. Posterior foveae without abrupt margins, partially obscured by large punctures. Anterior foveae very slightly developed, nearly totally obscured by punctation. Posterolateral angles with shallow impressions. Prosternum with very weakly developed median carina ended at coxal cavities; coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 1.08 mm; maximum width (near midlength) 0.72 mm. Disc slightly convex, dull, with six rows of large round punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; punctures round; intervals rounded, subcostate, width equal to 0.50 puncture width; interstices between punctures thin walls; each puncture with seta. Explanate margin slightly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.5:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 113C)(23 examined).

Variation. – Specimens available are quite homogeneous in external characteristics.

Natural History. – I collected more than 100 specimens from one section of shoreline bordering the creek at Wilbur Hot Springs. The water was warm to the touch and, presumably, the ultimate reason for abundance of these beetles and other aquatic insects observed. The single specimen known from outside the hot spring area was collected only nine miles away.

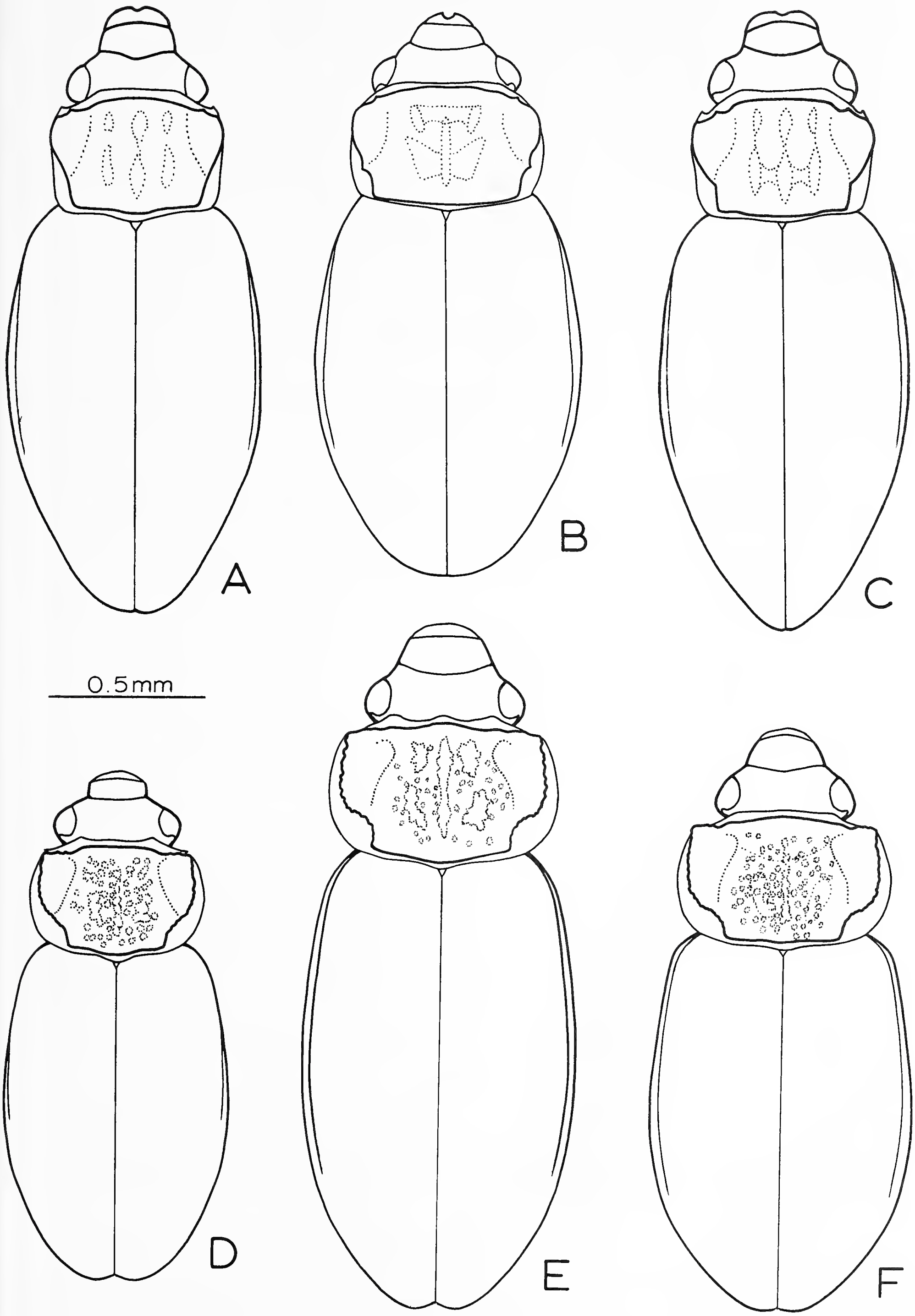
Distribution. – (Figs. 101E,182A). Known only from Wilbur Hot Springs area, Colusa County, California.

Etymology. – *rectus* plus Latin *ulus* (diminutive suffix). I refer to the small size and similarity to *O. rectus.*

Remarks. – I am grateful to Hugh B. Leech for suggesting that this locality might be interesting, and for providing directions.

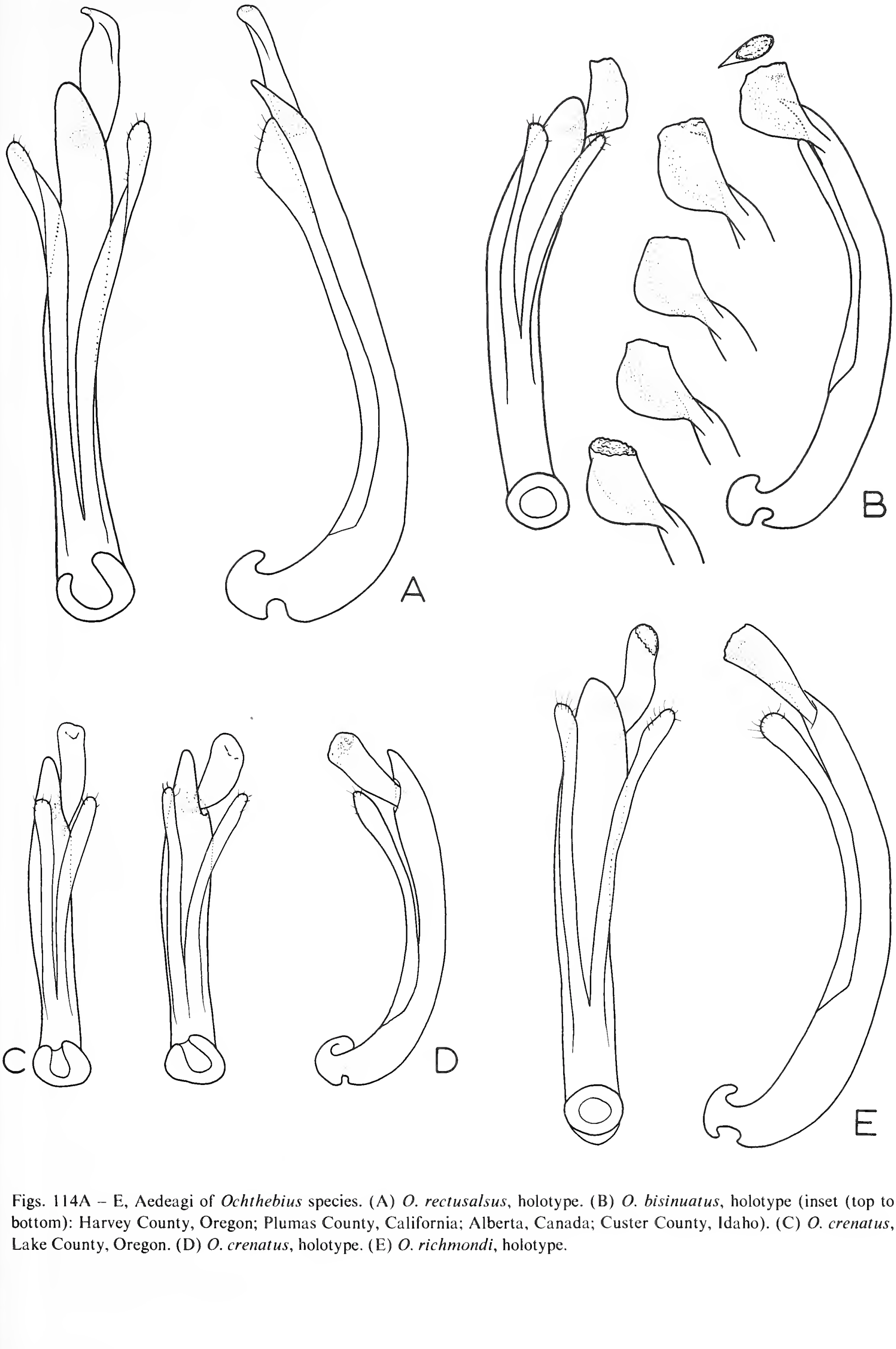
The *bisinuatus* Group

This group is characterized by the bisinuate anterior pronotal margin. Generally speaking,



Figs. 112A – F, *Ochthebius* body outlines. (A) *O. alpinopetrus*. (B) *O. tubus*. (C) *O. spanglerorum*. (D) *O. recticulus*. (E) *O. rectus*. (F) *O. rectusalsus*.

Figs. 113A – C, *Ochthebius* aedeagi. (A) *O. rectus*, variation in aedeagal apex. (B) *O. rectus*, San Benito County, California. (C) *O. recticulus*, holotype.



Figs. 114A – E, Aedeagi of *Ochthebius* species. (A) *O. rectusalsus*, holotype. (B) *O. bisinuatus*, holotype (inset (top to bottom): Harvey County, Oregon; Plumas County, California; Alberta, Canada; Custer County, Idaho). (C) *O. crenatus*, Lake County, Oregon. (D) *O. crenatus*, holotype. (E) *O. richmondi*, holotype.

most of these species are small, roughly sculptured and genitalically conservative.

Geographically the group is found in the western United States and adjacent Canada, with most specimens in the Pacific Coast states and all of the six presently included members with at least part of their range in California.

14. *Ochthebius bisinuatus* new species
(Figs. 101F,114B,115A-E,116F,181A)

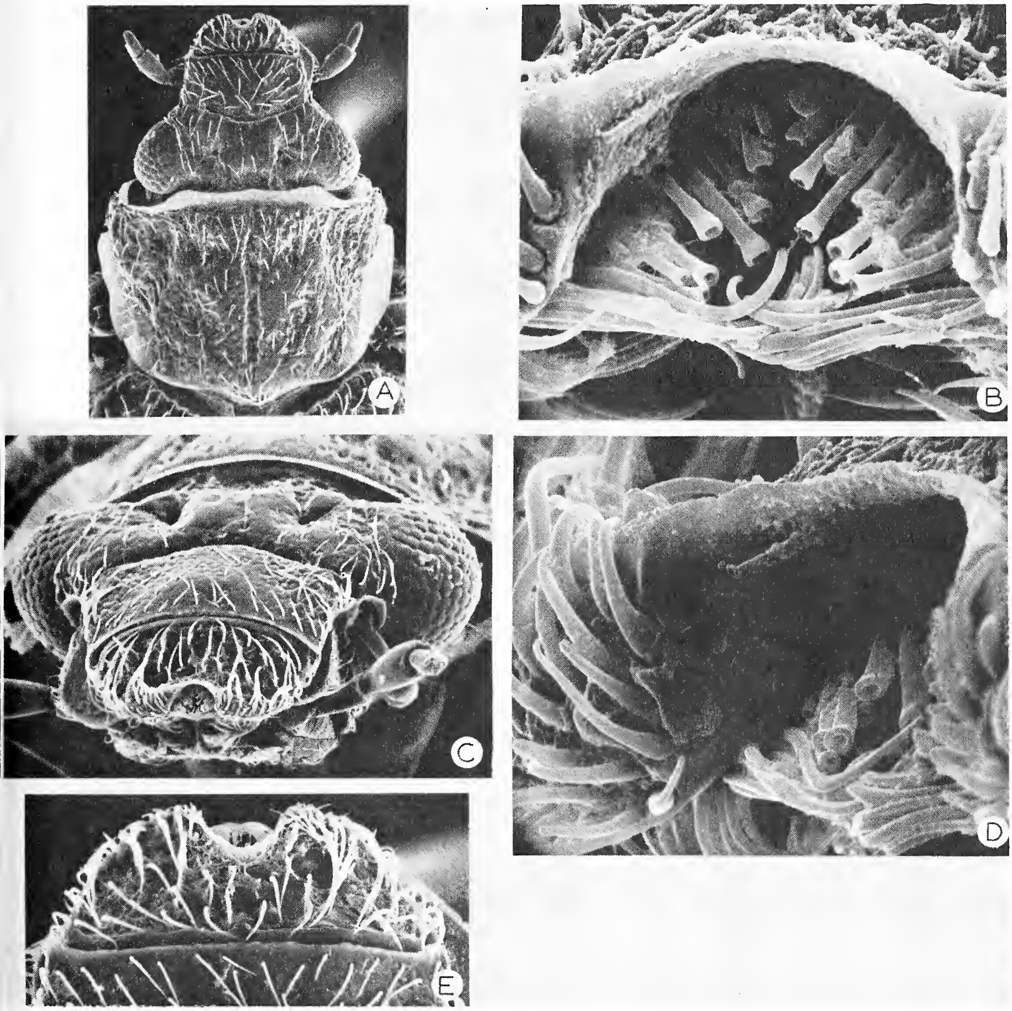
Type-locality. – Trinity River at Big Flat, Trinity County, California, U.S.A.

Type-specimens. – Holotype male and allotype, which have identical locality data, are deposited in CAS. They were collected by Hugh B. Leech, August 4, 1960. Data about paratypes (478) are listed in the appendix.

Diagnosis. – Within the *bisinuatus* Group, males of this species are distinguished by aedeagal form and lack of the following external modifications characteristic of other species of the group: crenate pronotum, costate elytra and broad hyaline borders which attain the anterior pronotal angles (Figs. 115A-E).

Description. – *Form:* Ovate, moderately convex (Fig. 116F). *Size:* Holotype 1.52 mm long, 0.68 mm wide. *Color:* Head and pronotum dark brown with slight copperish and bluish reflections, remainder lighter brown. *Head:* Length 0.30 mm; width 0.40 mm; Frons with fine microreticulation and shallow, slightly larger punctures randomly spaced, moderately dull, with very fine, indistinct hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large and distinct; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with punctation and hairs as on frons. Labroclypeal suture straight. Labrum length 0.33 width; surface with fine microreticulation and dense hairs; median emargination moderately deep and wide, depth nearly 0.33 length of labrum, width 0.20 width of labrum, edge very slightly upturned; lobes at angle to remainder of labrum. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 nearly 0.50 length of 3. Mentum width and length equal, anterior margin deeply arcuate to rear; surface very smooth and shiny, with shallow, small punctures. Submentum evenly, finely punctulate, punctures contiguous. Genae dull, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (at anterior 0.33) 0.52 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near anterior 0.33 of lateral depression, extended slightly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum distinctively bisinuate, with very small irregularities in front of lateral fossulae and without shallow excavation in front of each lateral depression; anterior angles acute. Lateral depressions flat, with fine microreticulation and small indistinct hairs; margins markedly arcuate, pronotum apparently constricted behind lateral depressions. Lateral fossulae with inner margin abrupt, posterior extreme tapered into lateral hyaline membrane. Pronotal disc convex, with extremely uniform, fine microreticulation; hairs not apparent. Median groove deep, wide, slightly constricted in posterior 0.50, nearly extended to anterior and posterior margins; surface sculpture as on disc. Anterior foveae moderately shallow, connected to median groove by shallow depression; lateral margin straight, elevated ridge. Posterior foveae oval, elongate and oblique, length slightly greater than twice width, width twice that of median groove; surface sculpture as on disc; lateral margins abrupt, all other margins indistinct. Posterolateral angles with distinct impressions. Prosternum elevated in midline but without obvious carina; coxae contiguous. Metasternum with glabrous area restricted to posterior 0.20; surface with very fine, dense punctures. *Elytra:* Length 1.00 mm; maximum width (near midlength) 0.68 mm. Disc moderately flat, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; most punctures slightly elongate; intervals flat, with fine irregular lines, width 1.50 puncture diameter; interstices between punctures 0.25 puncture length; each puncture with a very small seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Of moderate build and length; ratio of hind leg length to abdominal length 1.9:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 114B)(67 examined).

Variation. – Northern specimens tend to be slightly darker, have the glabrous metasternal area larger, and have the microreticulation somewhat reduced (resulting in a more reflective pronotal disc). Specimens from California form a recognizable group characterized by microreticulation more markedly developed than most specimens from the remainder of the range. This section of California, from the San Francisco bay area to the California–Oregon border, is the only area of sympatry of *O. bisinuatus* and *O. californicus*. The latter is the



Figs. 115A – E, *Ochthebius bisinuatus*. (A) head and pronotum. (B) labral emargination and sensilla, anterior view. (C) head, anterior view. (D) labral emargination and sensilla, oblique view. (E) labrum, dorsal view.

species most closely similar to *O. bisinuatus*. Development of microreticulation of non-Californian specimens of *O. bisinuatus* more closely approximates that of *O. californicus*, and perhaps character displacement is acting upon the California population of *O. californicus* to produce a greater development of the microreticulation, especially that of the pronotum. If so, texture of the pronotum must be involved in species recognition.

Some specimens of *O. bisinuatus* from Alberta, near the known northern distributional limit, have the following features which differ from the holotype: 1) nearly black in color; 2) prosternal carina present, 3) glabrous area of metasternum well developed, 4) microreticulation reduced, surface more reflective; 5) median groove constricted in middle, 6) anterior foveae not connected to median groove by a shallow depression; 7) median extremes of posterior foveae distinct and 8) elytral punctures slightly larger, less elongate. Despite these differences there is

a general similarity in body shape and most other characters, including the male genitalia (Fig. 114B), and I have no doubt that these differences are expressions of semi-clinal variation within the species. The one specimen (male) I have seen from the easternmost known locality, Natrona Co., Wyoming, compares more closely with specimens from the northern extreme of the distribution than with those from the southern extreme, further indication of isolation of the southern population. Females are very similar to males, but lack protarsal suction setae and labral lobes are not at an angle to the remainder of the labrum.

Distribution. – (Figs. 101F,181A). Principally a species of the United States Pacific Northwest, but ranging as far south as central California, as far north as British Columbia, and as far east as central Wyoming.

Etymology. – Latin *bi* (two) plus *sinuatus* (curve). Named in reference to the bisinuate anterior margin of the pronotum.

15. *Ochthebius californicus* new species
(Figs. 10B,116D,117B,118D,181A)

Type-locality. – Kern river, 9.5 road miles N. of Kernville, Tulare County, California, U.S.A.

Type-specimens. – The holotype male and allotype, which have identical locality data are deposited in CAS. Hugh B. Leech collected them March 25, 1970. Data about paratypes (116) are presented in the appendix.

Diagnosis. – Small size, rugulose pronotum, bisinuate anterior pronotal margin with crenulations behind the eyes, and the broad lateral hyaline borders which attain the anterior angles of the pronotum serve as diagnostic features for this rather distinctive species. Refer to the section on variation for a comparison with *O. bisinuatus*.

Description. – *Form:* Slightly truncate, convex (Fig. 116D). *Size:* Holotype 1.41 mm long, 0.61 mm wide. *Color:* Entire body dark brown, moderately reflective. *Head:* Length 0.28 mm; width 0.38 mm. Frons with dense, deep, moderately large punctures, some punctures subconfluent, surface moderately shining, with fine hairs; interocular foveae deep and large, width of each equal to distance between them; interocular tuberculi small, indistinct; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture bisinuate. Clypeus length 0.50 width; with fine microreticulation and fine, sparse hairs. Labroclypeal suture straight. Labrum length 0.33 width; surface somewhat rugulose, with fine, sparse hairs; median emargination moderately deep and somewhat narrow, depth nearly 0.33 length of labrum, width nearly 0.25 width of labrum; lobes upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 nearly 0.50 length of penultimate. Mentum square, shining, with small punctures separated by puncture diameter. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.34 mm; maximum width (at anterior 0.25) 0.54 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin at anterior angles, divergent from pronotum in anterior 0.25, thence extended arcuate to posterior angles, narrow around posterior margin. Anterior margin of pronotum distinctly bisinuate, with crenulations in front of lateral fossulae and very shallow excavation in front of each lateral depression; anterior angles acute. Lateral depressions flat, somewhat rugulose, with small indistinct hairs; margins markedly arcuate, pronotum constricted behind lateral depressions. Lateral fossulae with inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc convex, punctures moderately large, quite close together and irregular in size, surface moderately rugulose; with fine short hairs. Median groove deep, wide, slightly constricted in middle 0.50, nearly extended to anterior and posterior margins; surface sculpture as on disc. Anterior foveae deep, suboval, subconfluent with median groove punctures very dense, confluent in some specimens; lateral margin straight and nearly parallel to median groove; median margin arcuate. Posterior foveae oval, elongate and oblique, length slightly greater than twice width, width slightly greater than width of median groove; surface sculpture as on disc; lateral margin abrupt, posterior extremes indefinite. Posterolateral angles with distinct impressions. Prosternal carina ended at coxal cavities; coxae contiguous. Metasternum with median glabrous area well developed, extended nearly full length of metasternum, triangular; surface with moderately large punctures, most punctures separated by puncture diameter. *Elytra:* Length 0.98 mm. maximum width (near midlength) 0.70 mm. Disc convex, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity beginning near posterior 0.33; most punctures round; intervals flat, width equal to puncture diameter; interstices between punctures 0.25

puncture diameter; each puncture with very small, indistinct seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Of moderate build and length; ratio of hind leg length to abdominal length 1.6:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 118D)(23 examined); female (Fig. 10B).

Variation. – Slight variation is exhibited. Some specimens have the pronotal sculpture very slightly coarser than the average. Females lack protarsal suction setae and do not have the labral lobes upturned. *O. californicus* is most closely similar to *O. bisinuatus*, and one who is unfamiliar with this group might experience some difficulty in differentiating some specimens of the two species. In general, *O. californicus* adults are slightly more robust, the pronotal hairs are slightly more apparent, and the surface is obviously more markedly sculptured than *O. bisinuatus* adults. More specifically, the lateral hyaline border of the pronotum has its anterior extreme at or very near the anterior angles in *O. californicus*, whereas it is near the anterior 0.33 of the lateral depressions in *O. bisinuatus*. Development of crenulations in front of the lateral fossulae are also of use, being more readily apparent in *O. californicus*. The male genitalia of the two species are easily distinguished (Figs. 114B,118D). Refer to the variation section of *O. bisinuatus* for comments on specimens from the area of sympatry of the two species.

Distribution. – (Figs. 117B,181A). Distributed throughout California; one locality known from Carson City in westernmost Nevada.

Etymology. – Named after the geographical distribution.

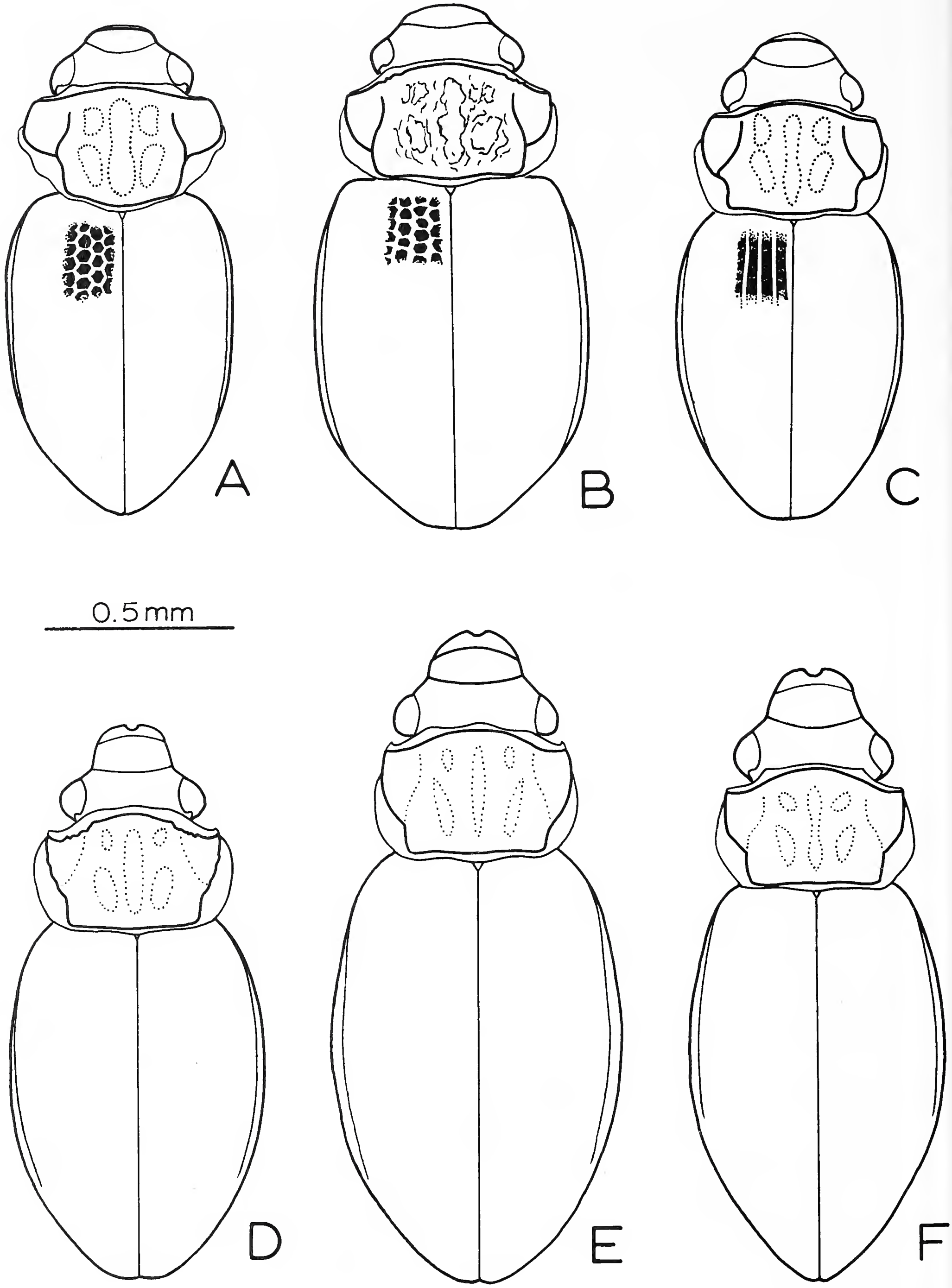
16. *Ochthebius richmondi* new species
(Figs. 114E,116E,117B,181A)

Type-locality. – Mad River 4 miles N. of Arcata, N. Bank road, Humboldt County, California, U.S.A.

Type-specimens. – The holotype male and allotype, which have identical locality data are deposited in CAS. Hugh B. Leech collected these specimens, October 1, 1965. Data about paratypes (117) are presented in the appendix.

Diagnosis. – I have not found any constant and distinctive sculptural differences between *O. richmondi* and its most closely similar relative, *O. bisinuatus*. However, larger size, 1.80 mm versus 1.68 mm, the deep black color, and form of the male genitalia (Figs. 114B,E) are diagnostic features.

Description. – *Form:* Elongate oval, moderately convex (Fig. 116E). *Size:* Holotype 1.80 mm long, 0.84 mm wide. *Color:* Dorsum and venter black, legs and palpi brown; moderately shiny, with faint brassy reflections on pronotum. *Head:* Length 0.32 mm; width 0.48 mm. Frons microreticulate, punctures separated by their diameters, some elevated areas shining; with very fine, sparse hairs; interocular foveae deep and large, width of each equal to distance between them; interocular tuberculi moderately large, shining; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with fine microreticulation, without obvious hairs. Labroclypeal suture straight. Labrum length 0.50 width; surface with microreticulation and fine, sparse hairs; median emargination of moderate depth and width, depth 0.33 length of labrum, width 0.25 width of labrum, edge slightly upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 nearly 0.50 length of 3. Mentum nearly square, with anterior margin arcuate to rear; with moderately large punctures separated by two-three times puncture diameter. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (at anterior 0.20) 0.62 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near anterior 0.33 of lateral depression, extended nearly straight to posterior angles, very narrow around posterior margin. Anterior margin of pronotum bisinuate, without crenulations in front of lateral fossulae; without shallow excavation in front of lateral depression; anterior angles obtuse. Lateral depressions flat, dull, punctate and microreticulate, with small indistinct hairs; margins strongly arcuate, pronotum constricted behind lateral depressions. Lateral fossulae with abrupt inner margin, posterior extreme tapered into lateral hyaline border. Pronotal disc convex,



Figs. 116A – F, *Ochthebius* body outlines. (A) *O. crassalus*. (B) *O. crenatus*. (C) *O. costipennis*. (D) *O. californicus*. (E) *O. richmondi*. (F) *O. bisinuatus*.

with distinctive microreticulation, punctures separated by puncture diameter; moderately shining; with fine, sparse, indistinctive hairs. Median groove moderately deep and wide, anterior 0.50 slightly wider than posterior; surface sculpture as on disc. Anterior foveae moderately deep, elongate oval, width of fovea slightly less than median groove, area between fovea and groove shallow depression equal to width of groove; lateral margin straight and nearly parallel to median groove; median margin indistinct. Posterior foveae oval, elongate and oblique, length slightly greater than twice width, width twice that of narrowest portion of median groove; surface sculpture as on disc; lateral margins abrupt, posterior extremes indefinite. Posterolateral angles with distinct impressions. Prosternum with very low carina ended at coxal cavities; coxae contiguous. Metasternum with median glabrous area moderately developed, suboval, restricted to posterior 0.50 of metasternum; surface with dense, fine punctures and sparse, fine hairs. *Elytra:* Length 1.24 mm; maximum width (near midlength) 0.84 mm. Disc moderately flat, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity beginning near posterior 0.33; most punctures round; intervals flat, width slightly greater than puncture diameter; interstices between punctures 0.50 puncture diameter; each puncture with very small seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 2.0:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 114E)(16 examined).

Variation. – Specimens from the three known localities compare quite favorably. Females lack protarsal suction setae and do not have the labral lobes upturned.

Distribution. – (Figs. 117B,181A). Known from one locality in western Washington and two in northern California.

Etymology. – I take pleasure in dedicating this species to the late E.A. Richmond in recognition of his contributions to the knowledge of hydraenid and hydrophilid larvae.

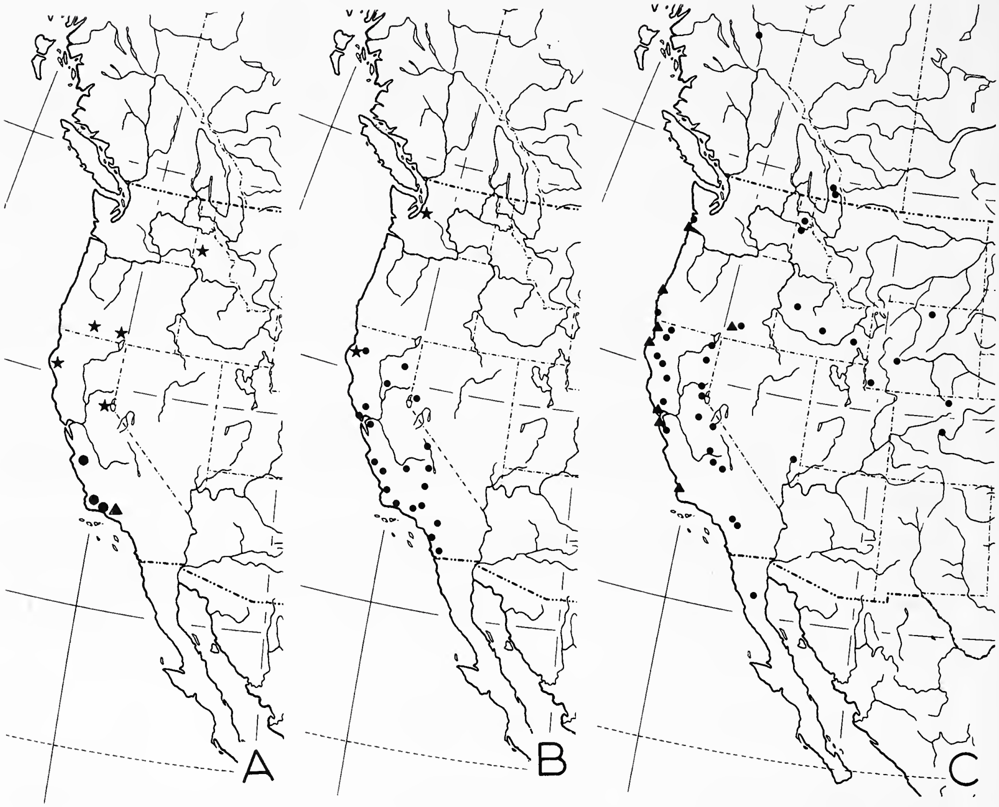
Remarks. – The series of 14 specimens from King County, Washington contained two specimens of *O. bisinuatus.*

17. *Ochthebius costipennis* Fall
(Figs. 116C,117A,118B,181A)

Ochthebius costipennis Fall, 1901:214 (holotype male in MCZ; type-locality: Ventura, California, U.S.A.). – Leech and Chandler, 1956:333).

Diagnosis. – The small size, approximately 1.30 mm long, rather broad form, and especially the costate elytral intervals are distinctive adult features of this rare species. Male genitalia and external characteristics are most similar to *O. californicus*, but there are very distinctive differences, including: 1) costate versus non-costate elytral intervals, 2) different pronotal shape, with *O. costipennis* having the lateral hyaline borders beginning near midlength of the lateral depressions whereas they begin at the anterior angles of the pronotum in *O. californicus* (Figs. 116C,D), and 3) different pronotal sculpture, *O. costipennis* having moderately large, discrete punctures and smooth punctural interstices on the disc whereas *O. californicus* has microreticulate punctural interstices in this area.

Description. – *Form:* Truncate, convex (Fig. 116C). *Size:* Holotype 1.32 mm long, 0.60 mm wide. *Color:* Body uniformly dark brown, moderately reflective. *Head:* Length 0.24 mm; width 0.36 mm. Frons with dense, deep, moderately large punctures, some punctures subconfluent, surface moderately shining, without obvious hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi small, indistinct; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with dense, deep, moderately large punctures as on frons, without obvious hairs. Labroclypeal suture evenly arcuate. Labrum length nearly 0.33 width; surface somewhat rugulose, with fine, sparse hairs; median emargination moderately deep and somewhat narrow, depth nearly 0.33 length of labrum, width 0.20 width of labrum, edge very slightly upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 nearly 0.50 length of 3. Mentum wider than long, moderately shining, with dense, deep, small punctures. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.34 mm; maximum width (at approximately midlength)0.51 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near midlength of lateral depression, extended slightly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum very shallowly bisinuate, with crenulations in front of lateral fossulae and very shallow excavation in front of lateral depression; anterior angles



Figs. 117A – C, Geographical distributions of *Ochthebius* species. (A) *O. costipennis* ●, *O. crenatus* ★ and *O. crassalus* ▲. (B) *O. californicus* ● and *O. richmondi* ★. (C) *O. borealis* ● and *O. uniformis* ▲.

obtuse. Lateral depressions convex, with large distinct punctures and small indistinct hairs; margins markedly arcuate, pronotum apparently constricted behind lateral depressions. Lateral fossulae wide, 0.50 width of lateral depression, deeply impressed, inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc convex, punctures moderately large, quite uniform, separated by puncture diameter; hairs not apparent; surfaces between punctures flat and smooth, but only moderately shiny. Median groove deep, wide, slightly constricted in middle 0.50, nearly extended to anterior and posterior margins; surface sculpture as on disc. Anterior foveae deep, suboval; width of fovea, median groove and area between them all approximately equal; lateral margin straight and nearly parallel to median groove; median margin arcuate. Posterior foveae oval, elongate and oblique, length slightly greater than twice width, width slightly greater than width of median groove; surface sculpture as on disc; all margins equally abrupt. Posterolateral angles with distinct impressions. Prosternum carinate; coxae contiguous. Prosternum with median carina ended near anterior 0.33. Metasternum with median glabrous area well developed, extended full length of metasternum, subrhomboidal; surface with moderately large punctures, most punctures separated by puncture diameter. *Elytra:* Length 0.86 mm; maximum width (near midlength) 0.62 mm. Disc convex, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity extreme, origin near midlength; most punctures round; intervals costate, width 0.50 puncture diameter; interstices between punctures 0.25 puncture diameter; each puncture with very small, indistinct seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, long hairs. *Legs:* Stout and short; when hind femur is at right angle to the midline tarsus extends to abdominal apex. *Genitalia:* Male (Fig. 118B)(1 examined).

Variation. – The few specimens studied (11) were rather homogeneous.

Distribution. – (Figs. 117A,181A) Known only from the coastal mountains between San Francisco and Ventura, California.

Remarks. – Male genitalia and habitus illustrated are drawn from a specimen collected at Lompoc, Santa Barbara County, California. They compare very closely with those aspects of the holotype.

18. *Ochthebius crenatus* Hatch
(Figs. 114C,D,116B,117A,181A)

Ochthebius crenatus Hatch, 1965:18 (holotype male in UWA; type-locality: Boville, Idaho, U.S.A.).

Diagnosis. – The crenulate pronotal disc serves to readily distinguish adults of the rare *O. crenatus* from those of all other New World *Ochthebius*. The elytra are also very distinctive, being quite convex and with large, deeply impressed punctures.

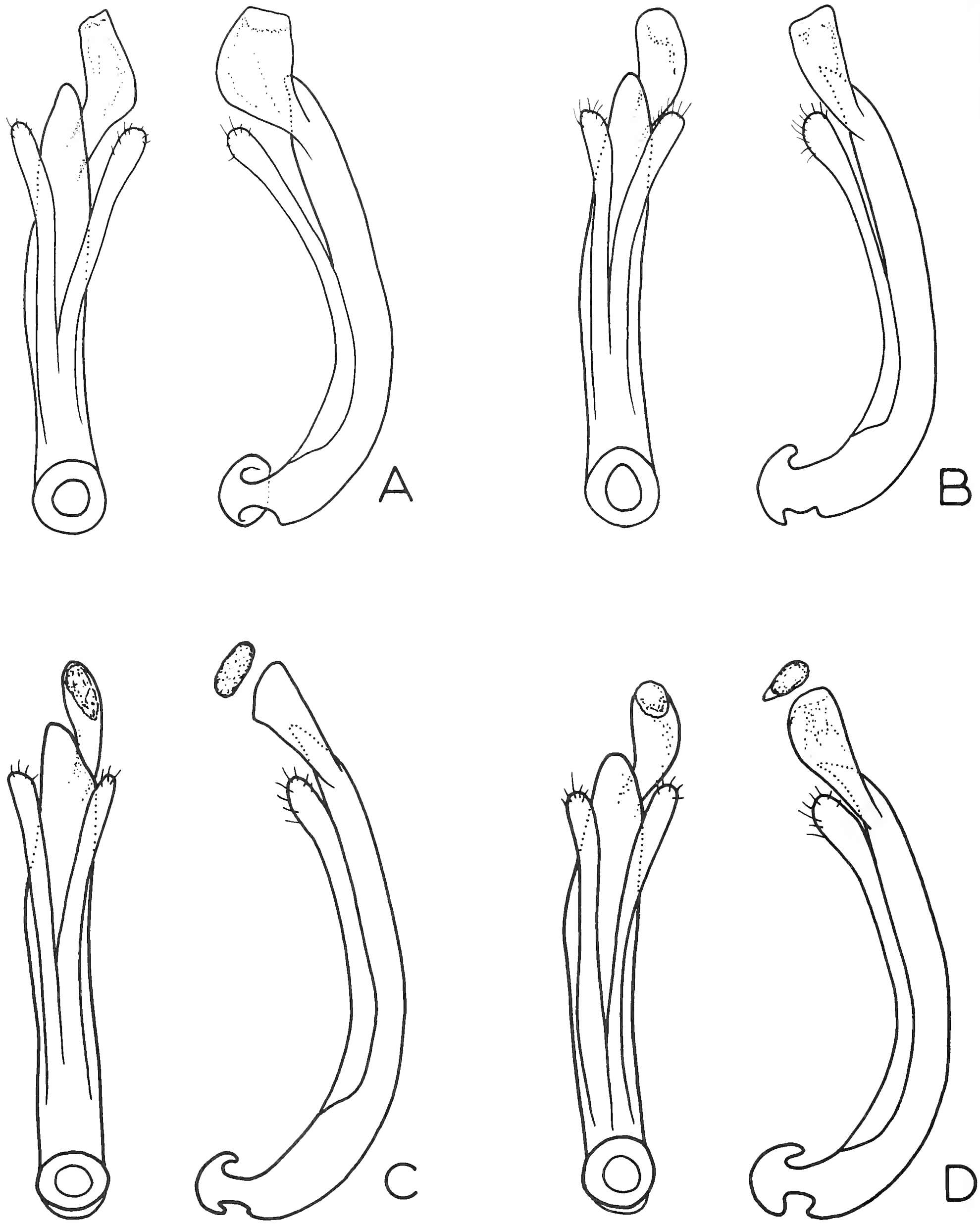
Description. – *Form:* Truncate, very convex (Fig. 116B). *Size:* Holotype 1.40 mm long, 0.72 mm wide. *Color:* Dorsum dark brown, nearly black; venter dark brown; moderately dull. *Head:* Length 0.28 mm; width 0.42 mm. Frons with dense punctures of varied sizes, some punctures subconfluent, surface moderately shining, with numerous short hairs; interocular foveae deep and large, width of each equal to distance between them; interocular tuberculi distinct; basomedial fovea nearly as deep and as wide as interocular foveae. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; microreticulate and punctate, punctures variously spaced, with numerous short hairs. Labroclypeal suture evenly arcuate. Labrum length nearly 0.50 width; surface somewhat rugulose, with fine, sparse hairs; median emargination moderately deep and wide, depth 0.33 length of labrum, width 0.33 width of labrum, edge very slightly upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 nearly 0.50 length of 3. Mentum square, moderately shining, with dense, small punctures. Submentum evenly, finely punctulate, punctures contiguous. Genae dull, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.38 mm; maximum width (at approximately midlength)) 0.58 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapering to anterior angles. Lateral hyaline border origin near anterior 0.20 of lateral depression, extended arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum very shallowly bisinuate, with small produced area in front of lateral fossulae and distinctive excavation in front of lateral depression; anterior angles acute. Lateral depressions flat, slightly rugulose, without distinct hairs; margins markedly arcuate, pronotum constricted behind lateral depressions. Lateral fossulae with outer margin tapered into lateral depression, inner margin abrupt, posterior extreme tapering into lateral hyaline border. Pronotal disc markedly convex, with dense deep punctures, surface crenulate; hairs not apparent; surfaces between punctures elevated ridges. Median groove deep, wide, slightly constricted in middle 0.50, nearly extended to anterior and posterior margins; surface sculpture as on disc. Anterior foveae deep, subtriangular, lateral margin an elevated ridge, median extreme confluent with median groove. Posterior foveae oval, elongate and oblique, length twice width, width slightly greater than width of median groove; surface sculpture as on disc; lateral margins elevated as irregular ridge. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with median glabrous area well developed, extended full length of metasternum, subrhomboidal; surface with moderately large punctures, most punctures separated by three times puncture diameter. *Elytra:* Length 1.00 mm. maximum width (near midlength)) 0.74 mm. Disc convex, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity extreme, beginning near midlength; most punctures round; intervals flat, width 0.50 puncture diameter; interstices between punctures 0.25 puncture diameter or less; each puncture with a distinct appressed seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence; pubescence very sparse in midline. Apical two segments smooth, midline and basal 0.50 glabrous, lateral, apical areas with very fine, short hairs. *Legs:* Stout and short; when hind femur is at right angle to the midline tarsus extends to posterior margin of abdominal segment 6. Protarsi without obvious suction setae. *Genitalia:* Male (Figs. 114C,D)(3 examined); female (Fig. 10D).

Variation. – The few specimens studied (19) were rather homogeneous.

Distribution. – (Figs. 117A,181A). Northern California, southern Oregon and northern Idaho.

19. *Ochthebius crassalus* new species
(Figs. 116A,117A,118A,181A)

Type-locality. – Ventura County, California, U.S.A.



Figs. 118A – D, Aedeagi of *Ochthebius* holotypes. (A) *O. crassalus*. (B) *O. costipennis*. (C) *O. sierrensis*. (D) *O. californicus*.

Type-specimen. – The holotype male (unique) is deposited in CAS. It was collected by F.E. Winters (date unknown).

Diagnosis. – The deeply sculptured pronotum, with its large median groove and foveae, gives to adults of this species a quite different appearance from those of the other members of the *bisinuatus* Group. The lateral depressions are quite convex and end abruptly at the posterior, resulting in a very unusual, thickened appearance. Elytral punctures are deeply impressed, large and round. These large punctures give the intervals a very irregular, somewhat zig-zag appearance. The intervals are not costate (Fig. 116A).

Description. – *Form:* Truncate, convex (Fig. 116A). *Size:* Holotype 1.20 mm long, 0.64 mm wide. *Color:* Entire body uniformly dark brown, moderately reflective. *Head:* Length 0.24 mm; width 0.36 mm.Frons with dense, deep, moderately large punctures, some punctures subconfluent, surface moderately shining, with short hairs; interocular foveae deep and large, width of each equal to distance between them; interocular tuberculi small, indistinct; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; rugulose, with numerous fine hairs. Labroclypeal suture evenly arcuate. Labrum length nearly 0.50 width; surface somewhat rugulose, with fine, dense hairs; median emargination shallow and somewhat narrow, depth nearly 0.25 length of labrum, width 0.17 width of labrum, edge very slightly upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 nearly 0.50 length of 3. Mentum square, moderately shining, with dense, deep, small punctures. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.36 mm; maximum width (at lateral depressions) 0.52 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near anterior 0.33 of lateral depression, extended nearly straight and undulating to posterior angles, very narrow around posterior margin. Anterior margin of pronotum very shallowly bisinuate, with very small crenulations in front of lateral fossulae and very shallow excavations in front of each lateral depression; anterior angles obtuse. Lateral depressions convex, with large distinct punctures and small indistinct hairs; posterior area very convex, appearing inflated; margins very markedly arcuate, pronotum greatly constricted behind lateral depressions. Lateral fossulae wide, 0.50 width of lateral depression, deeply impressed, inner margin abrupt, posterior extreme arching ventrad to meet lateral hyaline border. Pronotal disc very convex, punctures moderately large, separated by puncture diameter; hairs sparse; surfaces between punctures flat and smooth, but only moderately shiny. Median groove very deep, wide, slightly constricted in posterior 0.50, nearly extended to anterior and posterior margins; surface sculpture as on disc. Anterior foveae deep, suboval, width of fovea equal to median groove; area separating median groove from fovea 0.50 width of fovea; lateral margin straight and nearly parallel to median groove; median margin arcuate. Posterior foveae oval, elongate and oblique, length slightly greater than twice width, width slightly greater than width of median groove; surface sculpture smoother than that on disc; all margins equally abrupt. Posterolateral angles with distinct impressions. Prosternum carinate, carina ended at coxal cavities; coxae contiguous. Metasternum with median glabrous area well developed, extended full length of metasternum, subrhomboidal; surface with moderately large punctures, most punctures separated by puncture diameter. *Elytra:* Length 0.84 mm; maximum width (near midlength) 0.64 mm. Disc subconvex, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity extreme, beginning near posterior 0.33; most punctures round; intervals flat, width 0.50 puncture diameter; interstices between punctures 0.25 puncture diameter or less; each puncture with distinct seta. Explanate margin weakly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Stout and short; when hind femur is at right angle to midline tarsus extends to abdominal apex. Protarsi without obvious suction setae. *Genitalia:* Male (Fig. 118A)(1 examined); female unknown.

Distribution. – (Figs. 117A,181A). Known only from the type-locality, Ventura County, California.

Etymology. – Latin *crassus* (thickened) plus *alus* (wing). I refer to the lateral depressions of the pronotum which extend prominently to the side, as "wings", and which are distinctively thickened at their posterior margins.

The *biincisus* Group

Members of this group have the anterior pronotal margin with more or less developed postocular emarginations and postocular processes, and the metasternum is entirely pubescent.

The pronotal features, in known species, reach their maximum expression in *O. mexcavatus* (Fig. 128A).

The group presently consists of 13 species and is found throughout Mexico and in the western United States. Two major subdivisions of the group are evident. One subdivision centers around *O. sculptoides* and has the pronotal pubescence slightly more prominent, dorsal surface generally duller and lateral depressions more convex. The other subdivision centers around *O. biincisus* and has the pronotal pubescence reduced, dorsal surface generally more reflective and lateral depressions flat. Certain species, however, have intermediate forms of this or that character. Consequently, I have not designated subgroups.

The most unusual morphological feature in a member of this group is the totally pubescent fifth abdominal sternum of *O. aztecus*. No other species of *Ochthebius (sensu stricto)* in the Western Hemisphere has this segment hydrofuge pubescent. In all other respects *O. aztecus* fits well within the *biincisus* Group, therefore I am considering the structure of abdominal segment 5 of little phylogenetic significance.

20. *Ochthebius attritus* LeConte
(Figs. 92A,102A-D,119C,180)

Ochthebius attritus LeConte, 1878:380 (holotype female in MCZ; type-locality: Haulover, Florida, U.S.A.). – Horn, 1890:23. – d'Orchymont, 1943:47. – Young, 1954:206.

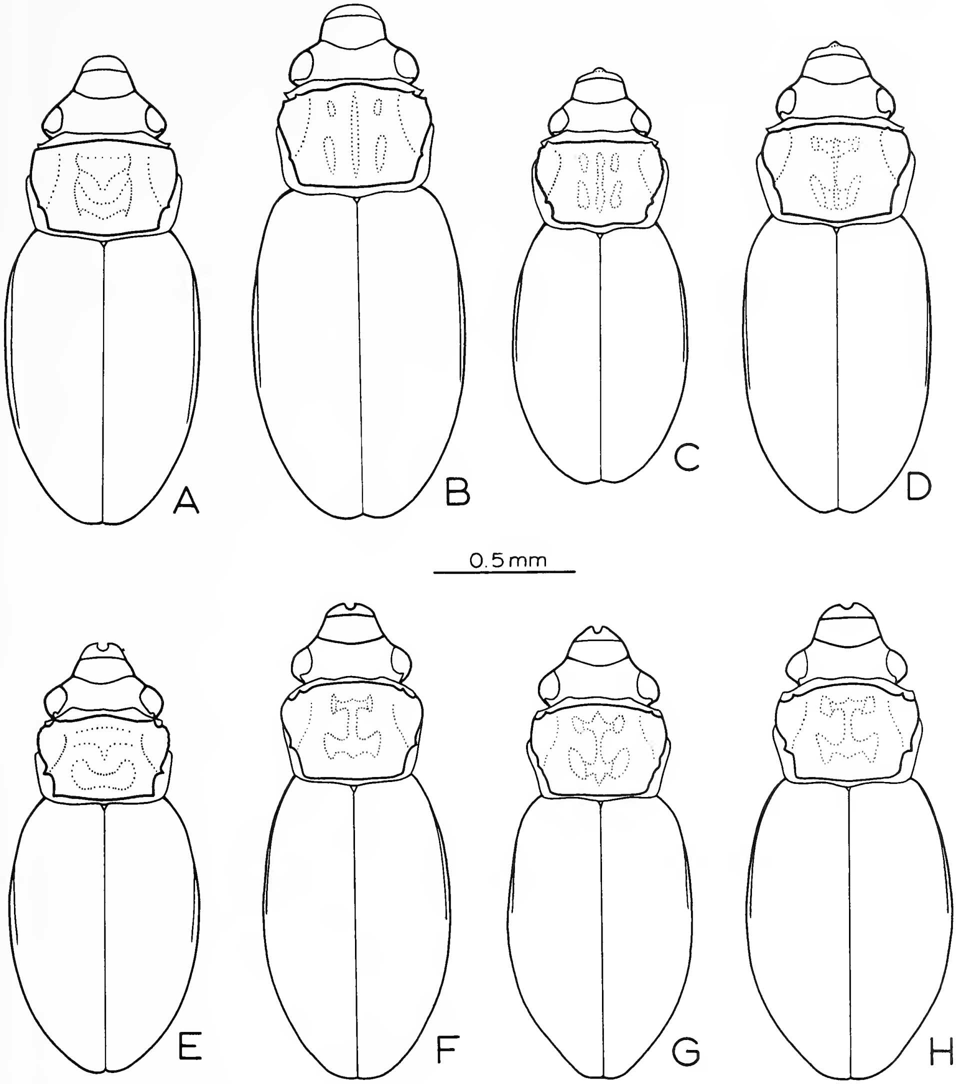
Ochthebius simplex LeConte, 1878:380 (holotype female in MCZ; type-locality: Haulover Florida, U.S.A.). – Horn, 1890:23. – Young, 1954:206.

Ochthebius schubarti d'Orchymont, 1943:47 (holotype male in ISNB; type-locality: Pernambuco, Brazil; new synonomy).

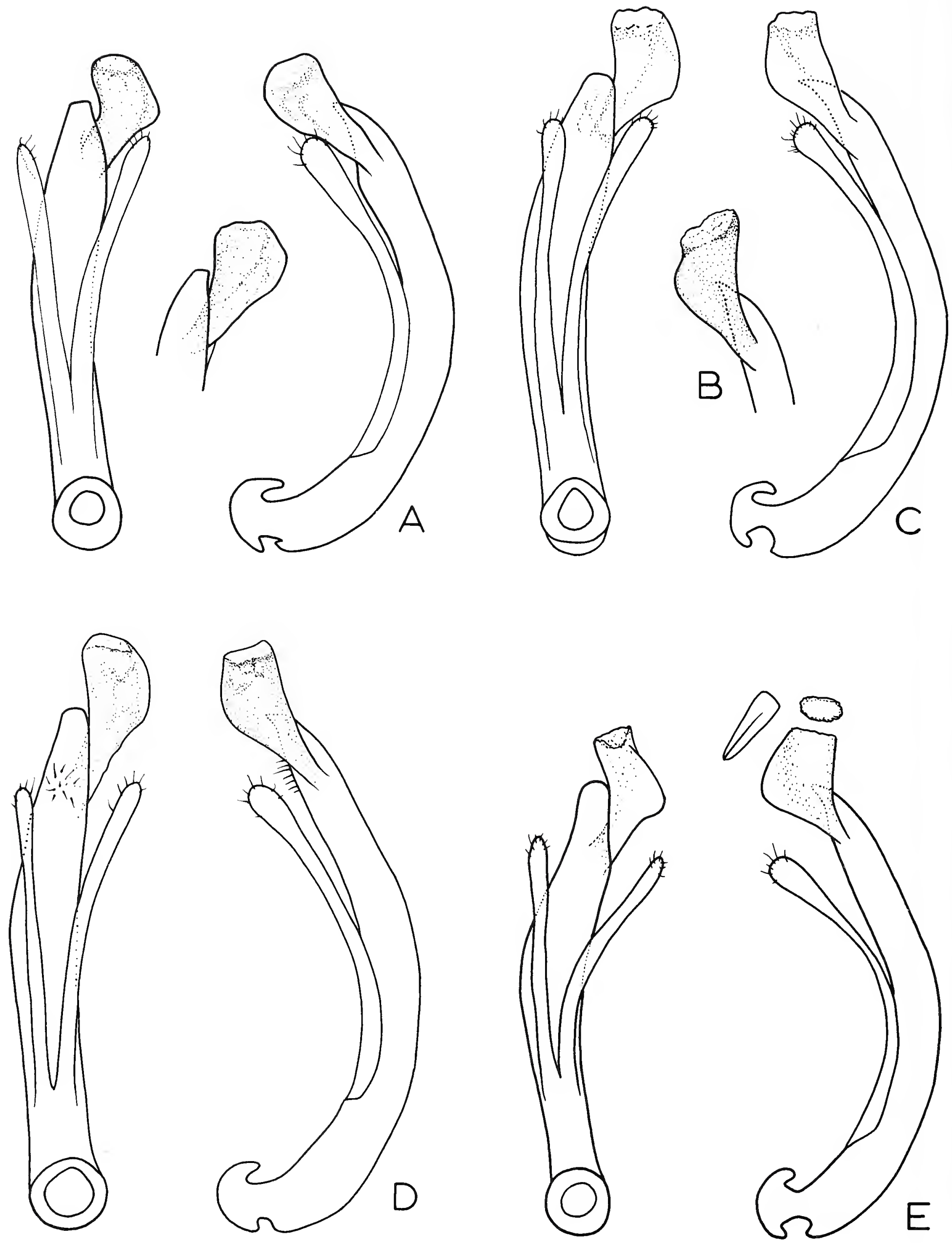
D'Orchymont's type does not differ significantly from LeConte's. The aedeagal form (Fig. 102C) is within limits of variation seen in this species.

Diagnosis. – Distinguished from other species in the *interruptus* Subgroup by the following combination of characteristics: 1) metasternum with large median glabrous area; 2) pronotum with prominent postocular processes and continuous median groove; and 3) testaceous color with metallic reflections. Very similar in both external and genitalic features to adults of *O. batesoni* Blair from the Galapagos Islands, but *O. attritus* has a circum-Caribbean-Gulf of Mexico distribution.

Description. – *Form:* Ovate, weakly convex (Fig. 119C). *Size:* Holotype 1.64 mm long, 0.68 mm wide. *Color:* Pronotum brown with faint bluish and coppery reflections; elytra lighter brown than pronotum, nearly testaceous; head dark brown; venter brown; legs, palpi and antennae testaceous. *Head:* Length 0.30 mm; width 0.42 mm. Frons slightly elevated, with fine, irregularly spaced punctures; lateral areas microreticulate; interocular foveae deep and large, width of each equal to distance between them; interocular tuberculi large; basomedial fovea nearly as deep and as large as interocular foveae. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with well developed microreticulation and fine hairs. Labroclypeal suture straight. Labrum length 0.33 width; surface with microreticulation and fine hairs; anterior margin upturned in midline in form of small tooth. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, with microreticulation and small punctures; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near anterior 0.33) 0.56 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near anterior 0.33 of lateral depressions, extended straight to posterior angles, very narrow around posterior margin. Anterior margin of pronotum straight in middle 0.50, slightly arcuate to rear in front of lateral fossulae; small excavation in front of each lateral depression, median to which is a small tooth; anterior angles acute. Lateral depressions convex, with fine, dense punctures; margins weakly arcuate, an extremely small tooth at posterior extreme; pronotum appearing slightly constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into small tooth at lateral hyaline border. Pronotal disc moderately convex, punctures in interfoveal area moderately small, irregularly spaced, some confluent; with fine, sparse hairs; surface between punctures smooth and shiny. Median groove in anterior connected



Figs. 119A – H, *Ochthebius* body outlines. (A) *O. lineatus*. (B) *O. aztecus*. (C) *O. attritus*. (D) *O. batesoni*. (E) *O. mesoamericanus*. (F) *O. sculptus*. (G) *O. sculptoides*, Yavapai County, Arizona. (H) *O. sculptoides*, Stanislaus County, California.



Figs. 120A – E, Aedeagi of *Ochthebius* species. (A) *O. aztecus*, lectotype (inset: apex rotated slightly). (B) *O. aztecus*, Durango, Mexico. (C) *O. aztecus*, Chapingo, Mexico, Mexico. (D) *O. aztecus*, San Bernardino County, California. (E) *O. sculptus*, San Bernardino County, California.

to anterior foveae by shallow transverse depression; posterior 0.50 of median groove absent; posterior foveae deeply confluent; latter with abrupt lateral margins; posteromedial areas broadly confluent in form of wide U-shaped depression with well developed punctation and microreticulation. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with well developed median glabrous area. *Elytra:* Length 1.08 mm; maximum width (near midlength)0.68 mm. Disc flat, moderately shiny with six rows of punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; punctures round; intervals rounded, not elevated, width equal puncture width, with some surface irregularities; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin slightly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.8:1.0. Protarsi without suction setae. *Genitalia:* Male (Figs. 102A-D)(11 examined).

Variation. – *O. attritus* exhibits a moderate degree of variation in pronotal sculpture. Most populations, including Floridian, Mexican and Puerto Rican, have the posterior foveae and posterior portion of the median groove joined by a shallow depression. However, the median groove and foveae are distinct from one another. The specimens I have studied from Colombia, in contrast, have the posterior foveae and median groove narrowly confluent and pronotal sculpture slightly coarser in general. The smooth extreme of pronotal sculpture is seen in specimens from Brownsville, Texas. The male genitalia (Figs. 102A-D) also vary, with the Floridian, Colombian and Brazilian populations closely similar, whereas specimens from Puerto Rico apparently form another subpopulation. The external features of the Puerto Rican specimens, however, are closely similar to those of specimens from the other subpopulations. Males differ from females in that the former have protarsal pads of suction setae and have the anteromedial margin of the labrum upturned to form a small tooth. Females have the labral anterior margin straight and not upturned, and lack protarsal pads. A total of 635 specimens were studied (see appendix).

Natural History. – Locality data and geographical distribution indicate facultative halophilic habits for *O. attritus*. Many specimens have been collected in brackish or even salt water habitats. Sometimes large numbers of specimens are taken at a single site; Flint and Spangler collected 480 at Playa Salina near Corozo, Puerto Rico ("in salt water"). The single specimen known from the Yucatan Peninsula was found "beneath debris on seashore".

Distribution. – (Figs. 92A,180). Antilles and mainland coastal areas of the Gulf of Mexico and the Caribbean Sea. Also known from one locality in easternmost Brazil.

21. *Ochthebius batesoni* Blair
(Figs. 119D,143D,180)

Ochthebius batesoni Blair, 1933:473 (holotype female deposited in BMNH; type-locality: Franklin Lake, James Island, Galapagos Islands).

Diagnosis. – Very similar and closely related to *O. attritus*, *O. batesoni* differs in aedeagal form (Figs. 102A-D,143D), and body shape, which is generally more paralled-sided and elongate than *O. attritus* (Figs. 119C,D). Refer to the diagnosis of *O. attritus* for further comments.

Description. – *Form:* Elongate, moderately convex (Fig. 119D). *Size:* Holotype 1.64 mm long, 0.72 mm wide. *Color:* Head and venter dark brown; legs, elytra and pronotum testaceous, the latter with faint metallic reflections. *Head:* Length 0.26 mm; width 0.42 mm. Frons with small, dense punctures, surface shining, hairs prominent; interocular foveae deep and large, width of each nearly equal to distance between them; interocular tuberculi large; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; microreticulate, with fine, moderately dense punctures and fine hairs. Labroclypeal suture straight. Labrum length 0.33 width; surface with microreticulation and fine hairs; median emargination absent; median 0.33 upturned to form a small tooth (males). Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, with small punctures; anterior margin arcuate. Submentum finely punctulate. Genae shining, swollen. Postgena finely

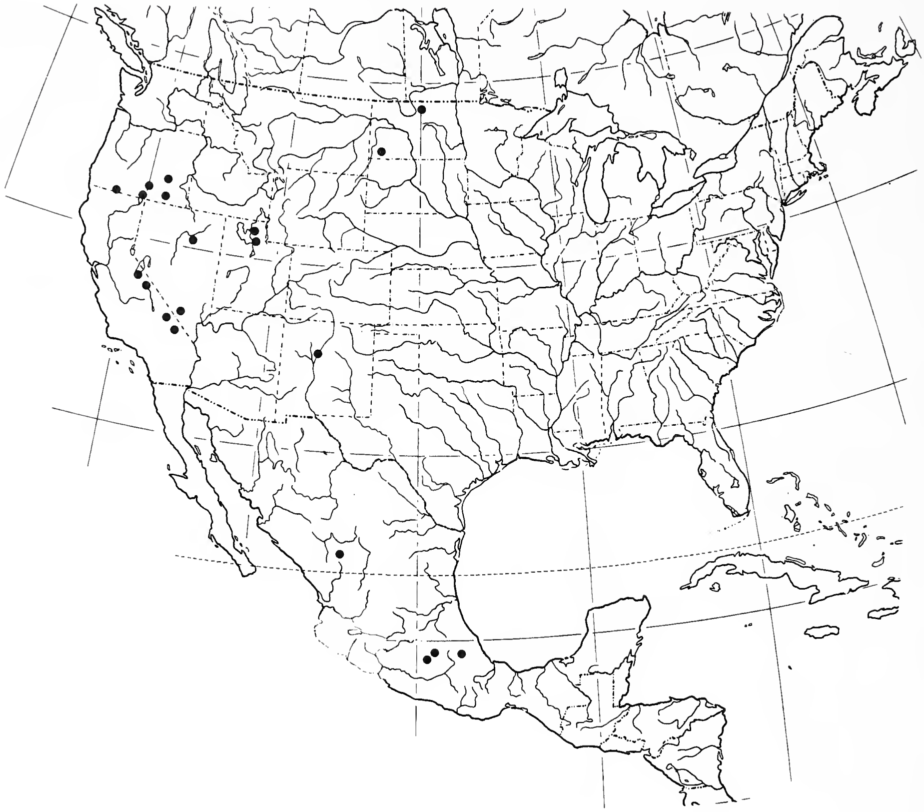


Fig. 121. Geographical distribution of *Ochthebius aztecus*.

punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near anterior 0.33) 0.56 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near midlength of lateral depression, extended straight to posterior angles, very narrow around posterior margin. Anterior margin of pronotum arcuate, without crenulations in front of each lateral depression; anterior angles obtuse. Lateral depressions flat, microreticulate with small, sparse punctures and fine hairs; margins moderately arcuate; pronotum slightly constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, punctures in interfoveal area moderately small, separated by one-three times puncture diameter; with fine, sparse hairs; surface between punctures smooth and shiny. Median groove well developed, microreticulate. Anterior foveae oval, deep, connected to median groove by microreticulate depression.

Posterior foveae oval, oblique, without abrupt lateral margins; posteromedial areas connected to median groove by microreticulate depression. Posterolateral angles with with distinct impressions. Prosternum slightly elevated in midline; coxae contiguous. Metasternum with well developed median glabrous area. *Elytra:* Length 1.08 mm. maximum width (near midlength) 0.72 mm. Disc flat, shiny, with six rows of punctures between suture ahd humeri. Sides convex, declivity beginning near posterior 0.33; punctures round; intervals flat, width equal puncture width, with very fine impressed lines; interstices between punctures 0.50 puncture length; each puncture with prominent seta. Explanate margin weakly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with moderately long hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 2.0:1.0. Protarsomeres 1-3 with suction setae (males). *Genitalia:* Male (Fig. 143D)(15 examined).

Variation. – Some specimens are uniformly dark brown and lack metallic reflections. Females lack protarsal suction setae and lack the upturned labral margin. A total of 52 specimens were studied (see appendix).

Natural History. – Specimens collected by Frank N. Young (see appendix) have the following note: "In salt lagoon back of beach...some shade from black mangrove growing around edges, water shallow, warm... beetles collected in sun-warmed portion cut-off by a bar... criss-crossed with stilt (bird) trails." Two specimens were found in the intestine of a flamingo collected on Isabel Island. This record of avian predation is unique among the Hydraenidae and indicates that at least one species is subject to selective pressure by filter-feeding birds.

Distribution. – (Fig. 180). Galapagos Islands.

22. *Ochthebius sculptoides* new species
(Figs. 119G,H,122A-F,123B,180)

Type-locality. – Santa Clara River, Santa Paula, Ventura County. California, U.S.A.

Type-specimens. – Holotype male and allotype with identical locality data are in CAS. They were collected by F.E. Blaisdell, July 20, 1923. Data about paratypes (242) are presented in the appendix.

Diagnosis. – Dull pronotum with confluent posterior foveae and convex lateral depressions, and the male genitalia serve to distinguish adults of this species. Refer to the sections on variation and remarks for further comments.

Description. – *Form:* Ovate, moderately convex (Figs. 119G,H). *Size:* Holotype 1.76 mm long, 0.80 mm wide. *Color:* Dorsum dark brown, venter slightly darker; legs slightly lighter. *Head:* Length 0.32 mm; width 0.44 mm. Frons with small, rather widely spaced punctures, surface moderately shining, with very fine hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi moderately large; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with extremely shallowly impressed microreticulation, nearly obsolete, punctures similar to those on frons, though somewhat denser, with fine hairs. Labroclypeal suture straight. Labrum length 0.33 width; surface somewhat rugulose, with fine, sparse hairs; median emargination of moderate depth and width, depth 0.33 length of labrum, width 0.25 width of labrum, lobes upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 nearly 0.50 length of 3. Mentum wider than long, moderately shining, with dense, small punctures. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near anterior 0.33) 0.60 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near midlength of lateral depression, extended straight to posterior angles, very narrow around posterior margin. Anterior margin of pronotum very arcuate, without crenulations in front of lateral fossulae and with shallow excavation in front of each lateral depression; anterior angles obtuse. Lateral depressions convex, with microreticulation, punctation and small indistinct hairs; margins moderately arcuate, with small tooth at base of lateral depression; pronotum moderately constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into tooth at lateral hyaline border. Pronotal disc moderately convex, punctures moderately small, separated by one-three times puncture diameter; with fine, sparse hairs; surfaces between punctures flat and smooth, but only moderately reflective. Median groove moderately deep, moderately wide at anterior and posterior, constricted in middle 0.50, not attaining anterior and posterior margins; microreticulation and punctures resulting in rugulose appearance. Anterior foveae moderately deep, confluent with median groove. Posterior foveae with abrupt lateral margins; posteromedial areas confluent with median groove; surface sculpture as in median groove. Posterolateral angles with distinct impressions.

Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 1.16 mm; maximum width (near midlength) 0.80 mm. Disc flat, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; most punctures somewhat elongate; intervals flat, width twice puncture width; interstices between punctures 0.50 puncture length; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 2.0:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Figs. 122A-F)(56 examined).

Variation. – This species is fairly uniform in external character states throughout its extensive range. There is some variation in depth of the pronotal median groove, posterior foveae, and the shallow depressions connecting the foveae to the posterior portion of the median groove. However, in all specimens studied the median groove is clearly evident between the posterior foveae. The male genitalia vary notably; I have illustrated the usual form (Fig. 122A) and some extremes (Figs. 122B-F). Because of overlap of character states between certain specimens of *O. sculptus*, *O. sculptoides*, and *O. tubus*, the male genitalia must be relied upon for positive identification (for further comments refer to the section on variation of *O. sculptoides* and *O. tubus*).

Natural History. – Most locality records indicate "creek" as the site; one record states "river in gravel but much algaceous slime" (B. Malkin), and a large series (56 specimens) was taken by the same collector at "Ziegler Hot Springs" in Madison County, Montana.

Distribution. – (Figs. 123B,180). Western North America from the U.S.A.–Canadian border to central Mexico. Easternmost known locality in the U.S.A. is in central Wyoming.

Etymology. – *sculptus* plus Greek suffix *oides* (resembling). I refer to the close resemblance to *O. sculptus*.

Remarks. – It is possible that *O. sculptus* and *O. sculptoides* are in reality a single species with several genitalic forms; that of *O. sculptus* being the most extreme variant. Although these two species are sympatric in California, I have not seen a composite series from a single locality, which might be cited as evidence for conspecificity. However, the genitalic variants of *O. sculptoides* are not morphologically intermediate between the form commonly seen in *O. sculptoides* and that of *O. sculptus*. Therefore, if they are conspecific, one must accept a fairly common spontaneous "morphological jump" to the extreme (*O. sculptus*) form. Additionally, one would need to explain the distribution in southern California, where only *O. sculptus* has been found. Sympatry of the two forms throughout much of California, plus lack of genitalic intermediates in geographically intermediate areas and, especially, the fact that other species of Western Hemisphere *Ochthebius* do not demonstrate genitalic morphological gaps of this magnitude without extensive geographical separation (see *O. lineatus*, for example) are the primary reasons for my decision that the material represents two species.

23. *Ochthebius sculptus* LeConte
(Figs. 119F,120E,123A,180)

Ochthebius sculptus LeConte, 1878:381 (lectotype female in MCZ, here designated; type-locality: Gilroy, California, U.S.A.). – Horn, 1890:24. – Leech and Chandler, 1956:333.

The syntype-series in the LeConte collection at the MCZ consists of two specimens. The lectotype has the following labels: Cala. d/ Type 3129/ *O. sculptus* Lec./ LECTOTYPE *Ochthebius sculptus* LeConte by P.D. Perkins 1977. According to LeConte's (1878) notes accompanying the original description, this specimen was collected at Gilroy, California. The second specimen is a male of another species (*O. biincisus*, new species); the following labels

are attached to the pin: Ariz./ Type 2 3129/ *sculptus* 2. Judging from Horn's (1890) redescription, he was apparently studying a specimen of *O. biincisus*.

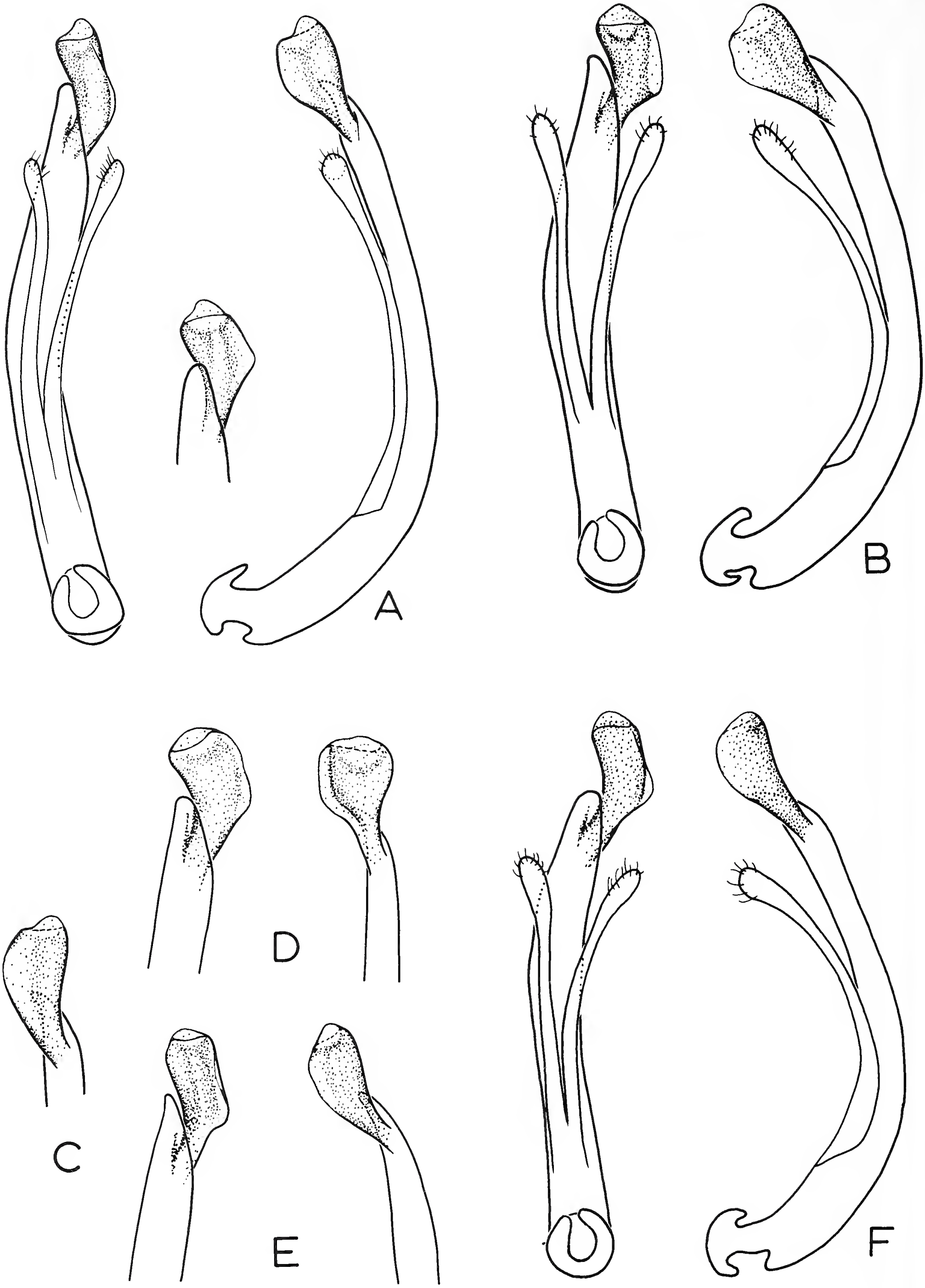
Diagnosis. – Convex lateral depressions, moderately deep postocular emarginations, and the male genitalia serve to distinguish this species. Refer to the sections on variation of *O. sculptoides*, *O. tubus*, and this species for further comment.

Description. – *Form:* Ovate, moderately convex (Fig. 119F). *Size:* Lectotype 1.72 mm long, 0.75 mm wide. *Color:* Dorsum and venter dark brown, nearly black; legs brown. *Head:* Length 0.28 mm; width 0.45 mm. Frons with small, rather widely spaced punctures, surface shining, with very fine hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi moderately large; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with extremely shallowly impressed microreticulation, nearly obsolete, punctures similar to those on frons, though somewhat denser; with fine hairs. Labroclypeal suture straight. Labrum length 0.33 width; surface somewhat rugulose, with fine, sparse hairs; median emargination of moderate depth and width, depth 0.33 length of labrum, width 0.25 width of labrum. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 nearly 0.50 length of 3. Mentum width equal length, moderately shining, with moderately dense, small punctures. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.38 mm; maximum width (near anterior 0.33) 0.56 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near midlength of lateral depression, extended straight to posterior angles, very narrow around posterior margin. Anterior margin of pronotum weakly arcuate, without crenulations in front of lateral fossulae and with shallow excavation in front of each lateral depression; anterior angles obtuse. Lateral depressions convex, with microreticulation, punctation and small hairs; margins moderately arcuate, with small tooth at base of lateral depression; pronotum slightly constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into tooth at lateral hyaline border. Pronotal disc moderately convex, punctures moderately small, separated by one-three times puncture diameter; with fine, sparse hairs; surfaces between punctures flat and smooth, very reflective. Median groove rather shallow, moderately wide at anterior and posterior, constricted in middle 0.50, not extended to anterior and posterior margins; with microreticulation and punctures, resulting in rugulose appearance. Anterior foveae moderately deep, confluent with median groove. Posterior foveae with abrupt lateral margins; posteromedial areas confluent with median groove; surface sculpture as in median groove. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 1.16 mm; maximum width (near midlength) 0.75 mm. Disc flat, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity beginning near posterior 0.33; most punctures round; intervals flat, with impressed, fine lines, width slightly greater than puncture width; interstices between punctures 0.50 puncture length; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 2.0:1.0. Protarsi without suction setae. *Genitalia:* Male (Fig. 120E)(37 examined).

Variation. – *O. sculptus* displays geographical variation in both form and sculpture, with a south-north increase in sculpture depth and in values for the ratio of elytral length to pronotal width. Therefore, specimens from Mexico appear somewhat smoother and broader than specimens from northern California. Degree of separation of anterior pronotal foveae from the posterior foveae varies independently of the former characters. In most specimens this separation is quite distinct, but few specimens possess a very narrow channel connecting the two foveae (on one or both sides of the pronotum). Externally, certain specimens of *O. sculptus*, *O. sculptoides*, and *O. tubus* are indistinguishable, but the male genitalia are quite distinct and must be studied for positive identification (further comments are presented under the sections on variation and remarks *O. sculptoides* and *O. tubus*). I have examined 147 specimens (see appendix).

Natural History. – Locality data indicate a lotic preference for *O. sculptus*, although a few specimens were collected at margins of lakes.

Distribution. – (Figs. 123A,180). Coastal mountain ranges of California and southern Oregon.



Figs. 122A – F, Aedeagi of *Ochthebius sculptoides*. (A) holotype (inset: apex rotated slightly). (B) Weber County, Arizona. (C) Aguascalientes, Mexico. (D) Cochise County, Arizona. (E) San Benito County, California. (F) Durango, Mexico.

24. *Ochthebius tubus* new species
(Figs. 3A,B,D,10A,11A,112B,124C,D,135B,148A,149A,C,152A,180)

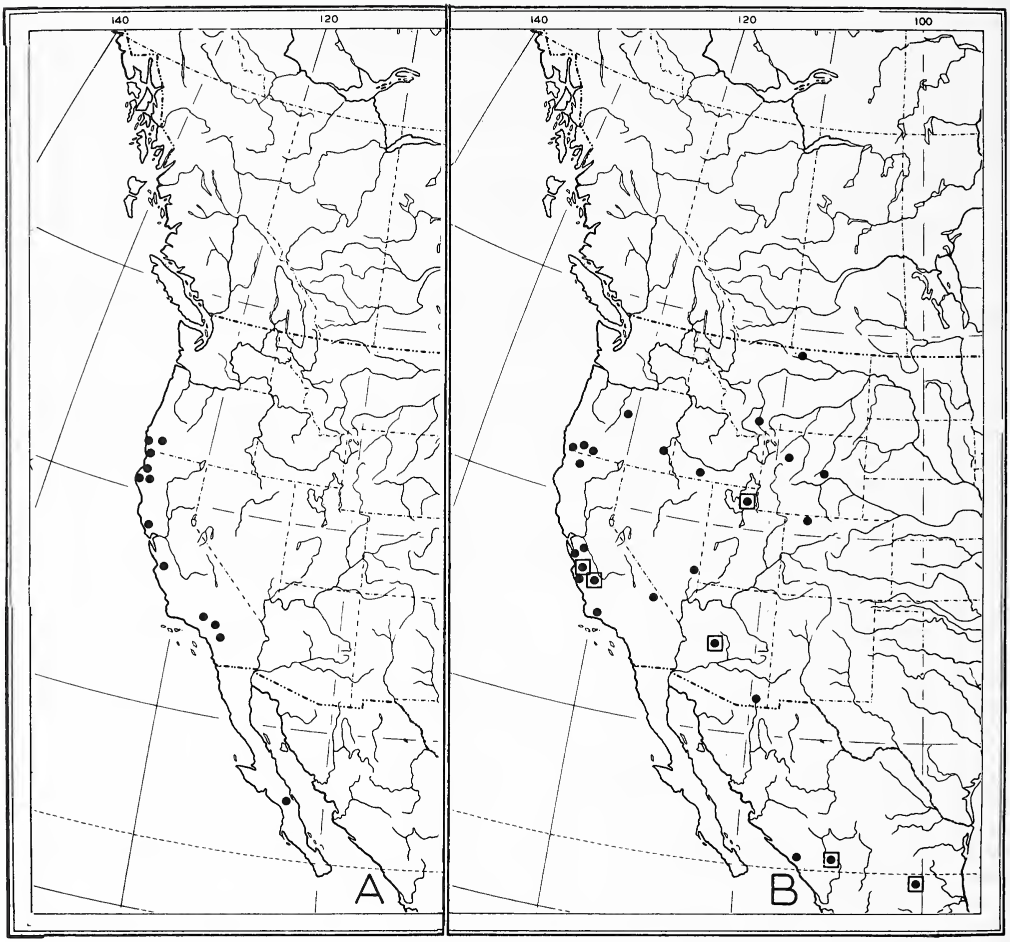
Type-locality. – Pool in canyon, elevation 3700 feet, La Suerte, Sierra San Pedro Martir, Baja California Norte, Mexico.

Type-specimens. – Holotype male and allotype with same locality data are in CAS. They were collected by R.K. Benjamin, June 4, 1963. Data about paratypes (282) are presented in the appendix.

Diagnosis. – Within the *biincisus* Group, distinguishing characteristics include: dull, microreticulate pronotal reliefs, confluent posterior foveolae, flat lateral depresssions, and male genitalia. Refer to section on variation for further comments.

Description. – *Form:* Ovate, moderately convex (Fig. 112B). *Size:* Holotype 1.76 mm long, 0.76 mm wide. *Color:* Dorsum dark brown, venter slightly darker; legs, palpi and elytral epipleura slightly lighter. *Head:* Length 0.34 mm; width 0.48 mm. Frons with moderately large, dense punctures in midline, surface shiny, with very fine hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi moderately large; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with punctures separated by one-three times puncture diameter, with fine hairs. Labroclypeal suture straight. Labrum length 0.33 width; surface somewhat rugulose, with fine, dense hairs; median emargination of moderate depth and width, depth 0.33 length of labrum, width 0.25 width of labrum, lobes upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 nearly 0.66 length of 3. Mentum width equal length, moderately shining, with sparse, small punctures; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near anterior 0.33) 0.60 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior gles. Lateral hyaline border beginning near midlength of lateral depression, extended straight to posterior angles, very narrow around posterior margin. Anterior margin of pronotum shallowly bisinuate, without crenulations in front of lateral fossulae and with very shallow excavation in front of each lateral depression; anterior angles obtuse. Lateral depressions flat, with dual, irregular punctation and small hairs; margins moderately arcuate; pronotum very slightly constricted behind lateral depresssions. Lateral fossulae moderately deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, punctures moderately small, separated by one-three times puncture diameter; with fine, sparse hairs; surface between punctures smooth and shiny. Median groove moderately deep, rather narrow, not extended to anterior and posterior margins; with microreticulation and punctures. Anterior foveae rather shallow, connected to median groove by shallow depression with well developed punctation. Posterior foveae with abrupt lateral margins; posteromedial areas confluent with median groove; surface sculpture as in median groove. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 1.12 mm; maximum width (near midlength) 0.76 mm. Disc flat, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity beginning near posterior 0.33; most punctures somewhat elongate; intervals flat, width equal puncture width; interstices between punctures 0.50 puncture length; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 2.0:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Figs. 124C,D)(77 examined); female (Fig. 10A).

Variation. – This species exhibits considerable variation in degree of development of the median groove and posterior foveae. At one extreme, the median groove and posterior foveae are quite distinct, with each fovea joined to the median groove by a shallow depression; at the other extreme, the posterior foveae are broadly and deeply confluent and the posterior portion of the median groove is absent. In the latter extreme, some specimens have the median groove unconnected to the confluent posterior foveae, and therefore duplicate the form seen in certain specimens of the *borealis* Subgroup (see discussion of variation under *O. borealis*, *O. marinus* *O. uniformis*, and *O. kaszabi*). *O. tubus*, however, differs from the aforementioned species in the shape of the labrum (deeply emarginate in both sexes) and shape of the anterior pronotal margin (compare Figs. 106A,112B). *O. tubus* also exhibits noteworthy variation in size of the acute process behind the lateral depression. At its greatest development this process is quite distinctive (Fig. 112B), but some specimens lack the process entirely, while in others this area is



Figs. 123A – B, Geographical distributions of *Ochthebius* species. (A) *O. sculptus*. (B) *O. sculptoides* (localities in squares are those for which aedeagi are illustrated in Figs. 122A-F).

very slightly indented. In the latter character state, however, the indentation does not approach the extent seen in such species as *O. pacificus* and *O. arenicolus* (Figs. 97A,B). *O. tubus* is most closely similar to *O. sculptus* and *O. sculptoides*. Depth of the pronotal foveae and degree of convexity of the lateral depressions are expressed maximally in some specimens of *O. sculptus*, but, as in other external characters, overlap between the three species is seen. The overlap of this and other external characters necessitates referral to the male genitalia for unequivocal species assignment (Figs. 120E,122A-F,124C,D).

Natural History. – Most commonly collected at the margins of streams. Altitude does not seem to be a limiting factor. Perkins (1976) discusses some details of the microhabitat preferences of *O. tubus* under the name *O. interruptus*.

Distribution. – (Figs. 135B,180). Western North America between the U.S.A.–Canadian border and central Mexico. Most frequently collected in California, where only one of the many records are from the Sierra Nevada Mountains, the remainder being from the coastal mountains and adjacent areas.

Etymology. – Latin, *tubus* (pipe). Named in reference to the shape of the aedeagal apical piece.

25. *Ochthebius alpinopetrus* new species
(Figs. 99B,112A,124B,180)

Type-locality. – Middle Casper Creek at Highway 20, ca. 2.5 mi. SE Natrona, Natrona County, Wyoming, U.S.A.

Type-specimens. – The holotype male and allotype, which have identical locality data, are deposited in CAS. Hugh B. Leech collected them August 20, 1965. Data about paratypes (14) are presented in the appendix.

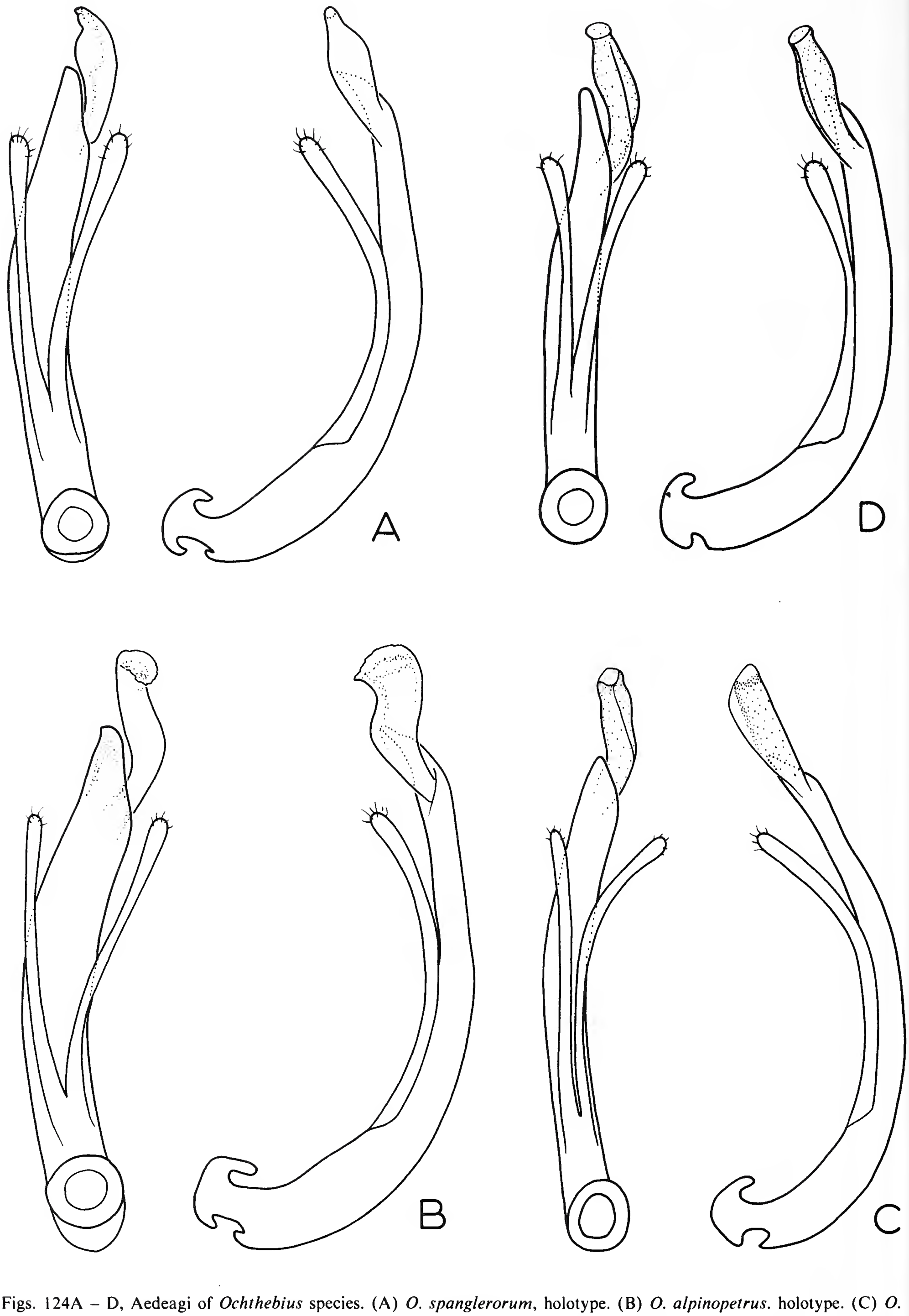
Diagnosis. – The male genitalia should be used to differentiate this species from *O. spanglerorum*. Refer to the sections on variation of the two species for comparisons.

Description. – *Form:* Elongate oval, weakly convex (Fig. 112A). *Size:* Holotype 1.96 mm long, 0.80 mm wide. *Color:* Head, pronotum and venter dark brown; elytra, legs and palpi brown. *Head:* Length 0.34 mm; width 0.46 mm. Frons with moderately large, dense punctures in midline, surface shiny, with very fine hairs, lateral areas microreticulate between punctures; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi moderately large; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width: microreticulate between somewhat dense, moderately large punctures; with fine hairs. Labroclypeal suture straight. Labrum length 0.33 width; surface with fine punctures and fine, dense hairs; median emargination rather shallow and narrow, depth 0.25 length of labrum, width 0.20 width of labrum, neither edge nor lobes upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 nearly 0.66 length of 3. Mentum width equal length, moderately shining, with sparse, small punctures; anterior margin arcuate. Submentum evenly, finely microreticulate. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (near anterior 0.33) 0.62 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near midlength of lateral depression, extended straight to posterior angles, very narrow around posterior margin. Anterior margin of pronotum shallowly bisinuate, without crenulations in front of lateral fossulae and with shallow excavation in front of each lateral depression; anterior angles obtuse. Lateral depressions slightly convex, microreticulate with irregular punctation and small hairs; margins moderately arcuate; pronotum moderately constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, interfoveal areas with moderately large punctures, separated by two-five times puncture diameter; with fine, sparse hairs; surface between punctures smooth and shiny. Median groove well developed in anterior and posterior, middle 0.50 constricted, reduced to a narrow, shallow sulcus; not extended to anterior and posterior margins; microreticulate. Anterior foveae well developed, elongate ovals separated from median groove by fovea width. Posterior foveae well developed, elongate ovals twice size of adjacent portion of median groove; separated from median groove by width of fovea; microreticulate. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 1.28 mm; maximum width (near midlength) 0.80 mm. Disc flat, moderately shiny, with six rows of punctures between suture and humeri. Sides convex, declivity beginning near posterior 0.33; most punctures round; intervals flat, width equal puncture width, with fine impressed lines; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin weakly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 2.0:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 124B)(6 examined).

Variation. – Slight variation in the pronotal sculpture was seen in the 16 specimens studied, and is discussed in relation to that of *O. spanglerorum*, in the section on that species.

Distribution. – (Figs. 99B,180). Rocky Mountains of Wyoming and Colorado.

Etymology. – Latin, *alpinus* (high mountains) plus *petrus* (rock). I refer to the geographical distribution, the Rocky Mountains.



Figs. 124A – D, Aedeagi of *Ochthebius* species. (A) *O. spanglerorum*, holotype. (B) *O. alpinopetrus*. holotype. (C) *O. tubus*, specimen from Val Verde County, Texas. (D) *O. tubus*, holotype.

26. *Ochthebius spanglerorum* Wood and Perkins (Figs. 99B,112C,124A,180)

Ochthebius spanglerorum Wood and Perkins, 1978:56 (holotype male in USNM; type-locality: Navajo Spring Creek, Montezuma County, Colorado, U.S.A.).

Diagnosis. – Nearly parallel lateral hyaline borders, shallow postocular emarginations, and short lateral depressions of the pronotum (Figs. 112A,C) are diagnostic features for *O. spanglerorum* and *O. alpinopetrus*. Aedeagal differences must be used to reliably distinguish males of these two species. Refer to the variation section for additional comparisons and comments.

Description. – *Form:* Elongate oval, weakly convex (Fig. 112C). *Size:* Holotype 1.92 mm long, 0.80 mm wide. *Color:* Head, pronotal disc and venter dark brown; pronotal lateral depressions, elytra, legs and palpi brown. *Head:* Length 0.30 mm; width 0.46 mm. Frons shallowly punctate in midline, shiny, very sparsely pubescent; lateral areas very faintly microreticulate; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi moderately large; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length slightly greater than 0.50 width, microreticulate, sparsely pubescent. Labroclypeal suture straight. Labrum length slightly less than 0.33 width; sparsely pubescent; median emargination small, depth 0.25 length of labrum, width 0.20 of labrum, neither edge nor lobes upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 nearly 0.66 length of 3. Mentum width equal length, moderately shining, with sparse, small punctures; anterior margin arcuate. Submentum evenly, finely microreticulate. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.42 mm; maximum width (near anterior 0.33) 0.58 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near midlength of lateral depression, extended straight to posterior angles, very narrow around posterior margin. Anterior margin of pronotum with shallow postocular emarginations; anterior angles obtuse. Lateral depressions convex, faintly microreticulate and punctate, shiny; margins moderately arcuate; pronotum moderately constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, moderately punctate, surface between punctures smooth and shiny. Median groove well developed in anterior and posterior, middle 0.50 constricted, reduced to narrow, shallow sulcus; not extended to anterior and posterior margins; microreticulate. Anterior foveae well developed, elongate ovals separated from median groove by fovea width. Posterior foveae well developed, elongate, ovals, microreticulate. Anterior and posterior pair of pits for pronotal sensilla rather well devloped. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum pubescent, without median glabrous area. *Elytra:* Length 1.20 mm; maximum width (near midlength) 0.80 mm. Disc flat, moderately shiny, with six rows of punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; most punctures round; intervals flat, width equal puncture width, with fine impressed lines; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin slightly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 2.0:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 124A)(29 examined).

Variation. – *O. spanglerorum* adults exhibit considerable variation in degree of separation of the anterior and posterior foveae of the pronotum, the foveae being distinctly separated on some specimens and narrowly confluent on others. In addition, microreticulation of the posterior foveae and median sulcus are contiguous on some specimens and non-contiguous on others. Since *O. alpinopetrus* shows these pronotal variations also, and is indistinguishable from *O. spanglerorum* on other external features, the male genitalia must be studied to distinguish specimens of these two closely related species.

Distribution. – (Figs. 99B,180). General region of the Rocky Mountains in the states of Colorado, New Mexico, North Dakota, Utah, and Wyoming, U.S.A.

27. *Ochthebius aztecus* Sharp (Figs. 96F,119B,120A-D,121,180)

Ochthebius aztecus Sharp, 1887:768 (lectotype male in BMNH, here designated; type-locality: Mexico City, Mexico). – d'Orchymont, 1943:40.

Ochthebius bruesi Darlington, 1928:3 (holotype male in MCZ; type-locality: Beowawe, Nevada, U.S.A.; new synonomy). – d'Orchymont, 1943:40. – Leech, 1966:137.

Darlington's type-specimen does not differ significantly from Sharp's type-specimen. I have illustrated the aedeagus of the lectotype of *O. aztecus* (Fig. 120A); the aedeagus of the holotype of *O. bruesi* is most similar to that illustrated from a specimen collected in Death Valley National Monument, California (Fig. 120D).

Diagnosis. – *O. aztecus* adults are readily distinguished by having the abdominal sternum 6 hydrofuge pubescent. Dorsally they are distinctive also because of the well separated, elongate posterior pronotal foveae and the discrete median groove which is gradually tapered to a point at the ends (Fig. 96F).

Description. – *Form:* Elongate, moderately convex (Fig. 119B). *Size:* Lectotype 1.84 mm long, 0.80 mm wide. *Color:* Head, pronotum and venter dark brown; elytra, legs and palpi light brown. *Head:* Length 0.30 mm; width 0.48 mm. Frons with moderately large, dense punctures in midline, surface shiny, with very fine hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi moderately large; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with moderately large punctures, microreticulation and fine hairs. Labroclypeal suture straight. Labrum length 0.33 width; with fine, dense hairs; median emargination absent, edge upturned slightly in midline. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, with sparse, small punctures; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.46 mm; maximum width (near anterior 0.33) 0.62 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near midlength of lateral depression, extended straight to posterior angle, very narrow around posterior margin. Anterior margin of pronotum arcuate, without crenulations in front of lateral fossulae; shallow excavation in front of each lateral depression; small tooth at the medial extreme of excavation; anterior angles acute. Lateral depressions convex, densely punctate, microreticulate, moderately pubescent; margins moderately arcuate; pronotum moderately constricted behind lateral depressions. Lateral fossulae deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, punctures small, separated by one-three times puncture diameter; with fine, sparse hairs; surface between punctures smooth and shiny. Median groove moderately deep, moderately wide, tapered at anterior and posterior; with microreticulation. Anterior foveae elongate, narrow and moderately deep; separated from median groove by three times fovea width. Posterior foveae very elongate, narrow and deep; parallel to median groove; separated from median groove by three times fovea width; surface microreticulate. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 1.20 mm; maximum width (near midlength) 0.80 mm. Disc flat, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity beginning near posterior 0.33; most punctures round; intervals flat, width equal puncture width, with extremely fine punctures and irregular lines; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal six sterna with hydrofuge pubescence. Apical segment smooth, basal 0.50 glabrous, apical 0.50 with long hairs. *Legs:* Long and slender; ratio of hind leg length to abdominal length 2.0:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Figs. 120A-D)(38 examined).

Variation. – Adults display notable variation in dorsal and aedeagal characters. Specimens from Mexico have more densely pubescent lateral pronotal depressions than have those from other areas. Pronotal sculpture is deepest on specimens from North Dakota. Some specimens from various localities have the head, prothorax and anterior margin plus humeri of the elytra very dark brown, which contrasts with the testaceous color of the remainder of the elytra. This contrast is especially pronounced in specimens from Oregon. The principal aedeagal variation has been illustrated (Figs. 120A-D). A total of 524 specimens were examined (see appendix).

Natural History. – Specimens are frequently collected in thermal springs and adjacent runoff areas, but the species is not restricted to those biotopes. Locality data also suggest an affinity for alkaline conditions.

Distribution. – (Figs. 121,180). Western United States southward to Mexico City and vicinity.

28. *Ochthebius biincisus* new species
(Figs. 125D,126A,127B,180)

Type-locality. – Little Sur River, vicinity of Pacific Ocean, Monterey County, California, U.S.A.

Type-specimens. – The holotype male and allotype with identical locality data are in USNM. I collected these specimens, September 6, 1970. Data about paratypes (32) are presented in the appendix.

Diagnosis. – Black color plus pronotal form with its deep postocular emarginations, deep, well separated foveae and deep median groove (Fig. 125D) serve to characterize this species.

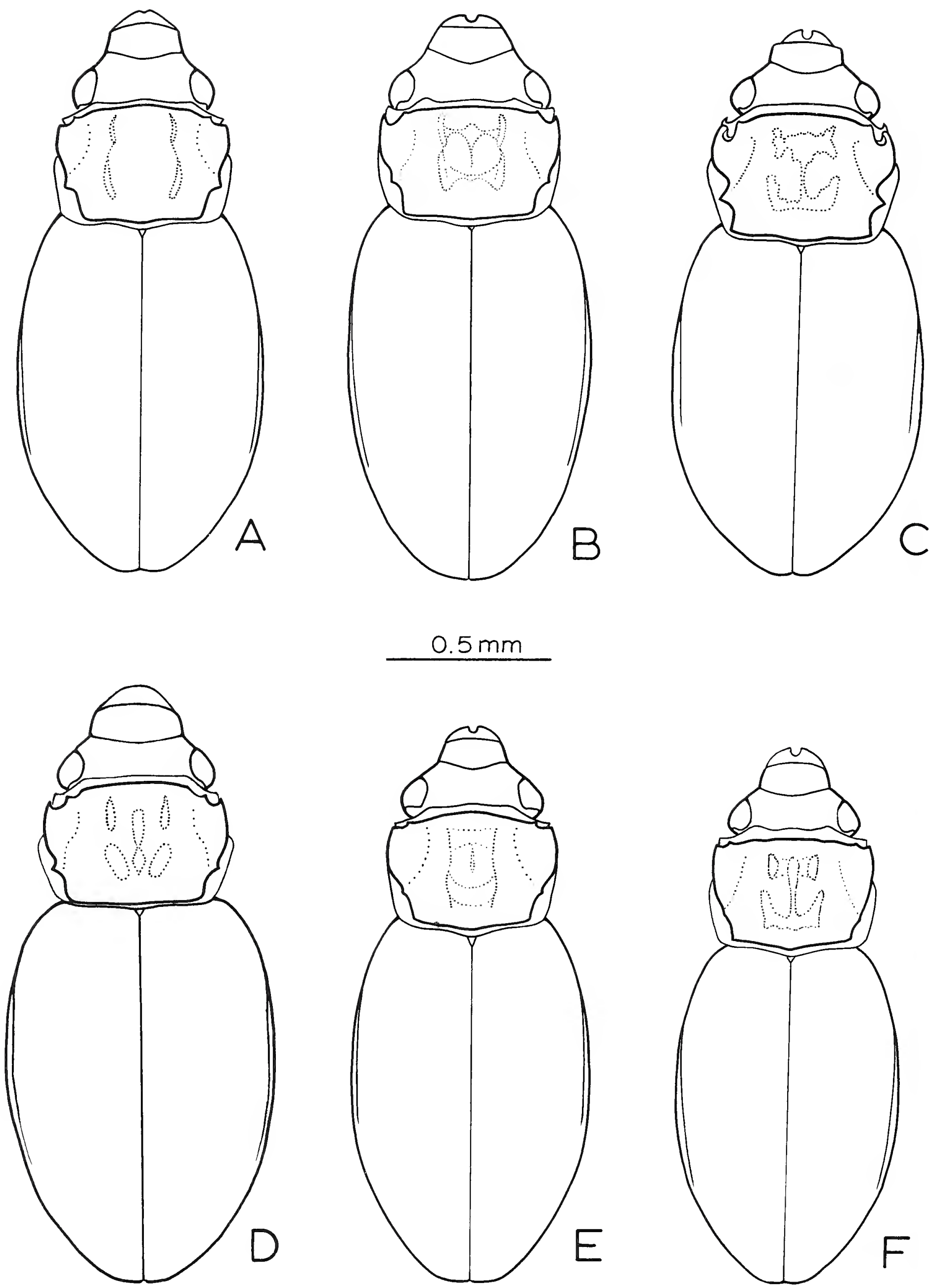
Description. – *Form:* Ovate, moderately convex (Fig. 125D). *Size:* Holotype 2.00 mm long, 0.92 mm wide. *Color:* Dorsum and venter black; legs and palpi light brown. *Head:* Length 0.32 mm; width 0.48 mm. Frons with moderately large punctures, separation one-three times puncture diameter, surface very shiny, with very sparse, fine hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi moderately large; basomedial fovea very small, not as deep as interocular foveae. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with moderately large, distinct punctures, separation one-three times puncture diameter, with very sparse hairs in lateral areas. Labroclypeal suture straight. Labrum length 0.33 width; surface with small punctures and dense hairs; median emargination very small, with upturned margin which makes emargination not visible from dorsal view. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 nearly 0.66 length of 3. Mentum width equal length, moderately shining, microreticulate, punctate, anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.42 mm; maximum width (near anterior 0.33) 0.64 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near midlength of lateral depression, extended very slightly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum shallowly bisinuate, without crenulations in front of lateral fossulae and with deep excavation in front of each lateral depression; anterior angles acute. Lateral depressions slightly convex, with microreticulation, irregular punctation and small indistinct hairs; margins moderately arcuate, with small tooth at base of lateral depression; pronotum moderately constricted behind lateral depressions. Lateral fossulae deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into tooth at lateral hyaline border. Pronotal disc moderately convex, punctures moderately small, separated by one-three times puncture diameter; with extremely fine, extremely sparse hairs; surfaces between punctures flat, smooth, and very shiny. Median groove moderately deep, wide at anterior and posterior, constricted in middle 0.50, not extended to anterior and posterior margins, microreticulate. Anterior foveae moderately deep, narrow and elongate. Posterior foveae oval, with all margins ended equally abrupt; surface sculpture as in median groove. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 1.36 mm; maximum width (near midlength) 0.92 mm. Disc flat, moderately shiny, with six rows of punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; most punctures somewhat elongate; intervals flat, width twice puncture width; interstices between punctures 0.50 puncture length; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.6:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 126A)(16 examined).

Variation. – The one specimen (male) from Oregon has the midlength constriction of the median groove slightly less well developed than in most specimens from California. Many specimens have testaceous or orange legs which contrast attractively with the deep black color of the body.

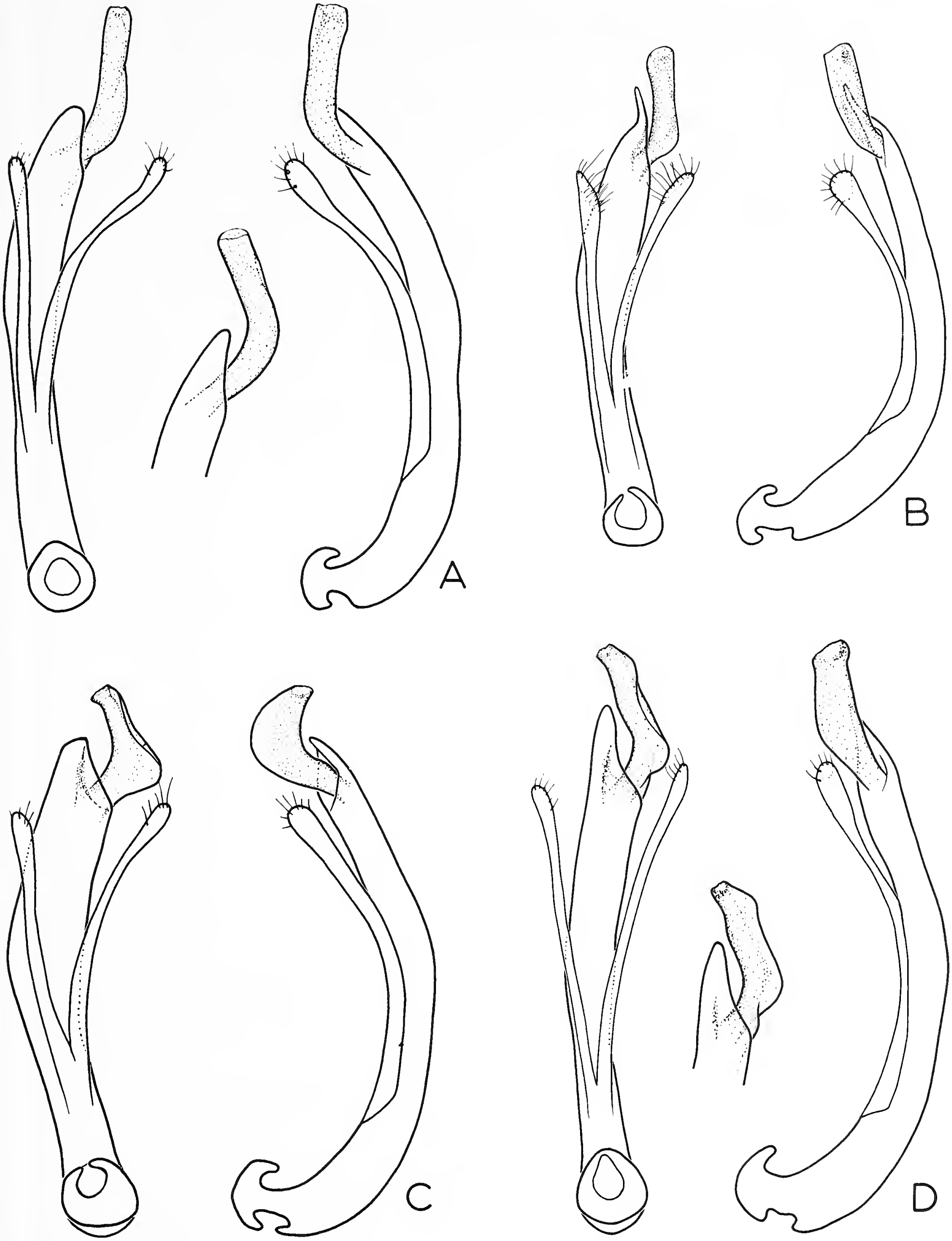
Natural History. – The series of 15 specimens from which the holotype was selected were collected at the margin of the Little Sur River, approximately 300 meters from where the river enters the ocean. Salinity measurements were not taken, but it seems highly probable that the water was brackish. The substratum consisted of rocks and sand. All other locality data suggest freshwater habitats.

Distribution. – (Figs. 127B,180). Pacific coastal mountain ranges from southernmost Oregon southward to Monterey County, California.

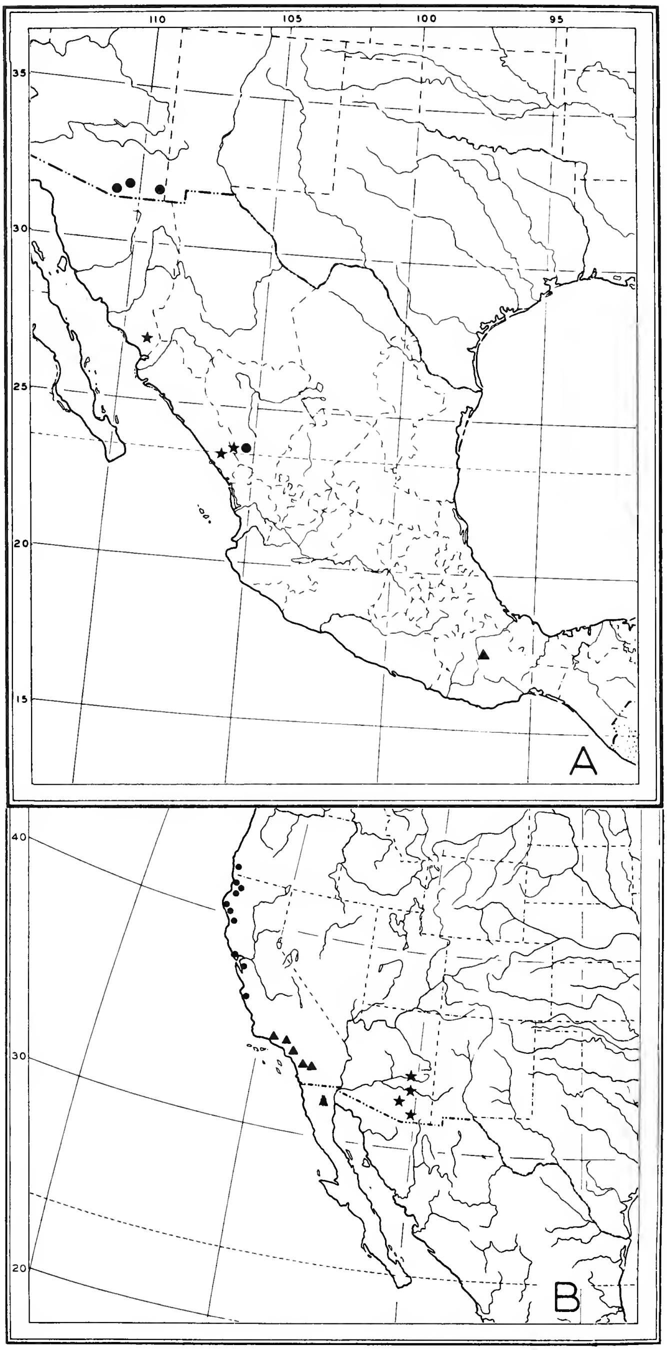
Etymology. – Latin *bi* (two) plus *incisus* (cut into). I refer to the deep postocular emarginations of the pronotum.



Figs. 125A – F, *Ochthebius* body outlines. (A) *O. obscurus*. (B) *O. gruwelli*. (C) *O. mexcavatus*. (D) *O. biincisus*. (E) *O. madrensis*. (F) *O. pauli*.



Figs. 126A – D, Aedeagi of *Ochthebius* species. (A) *O. biincisus*, holotype (inset: apex rotated slightly). (B) *O. obscurus*, lectotype. (C) *O. gruwelli*, holotype. (D) *O. arizonicus*, holotype (inset: apex rotated slightly).



Figs. 127A – B, Geographical distributions of *Ochthebius* species. (A) *O. madrensis* ●, *O. mexcavatus* ★ and *O. pauli* ▲. (B) *O. biincisus* ●, *O. arizonicus* ★ and *O. gruwelli* ▲.

29. *Ochthebius gruwelli* new species
(Figs. 125B,126C,127B,180)

Type-locality. – 2.2 miles SE El Topo, Sierra Juarez, Baja California Norte, Mexico.

Type-specimens. – The holotype male is in USNM. It was collected, March 25, 1970 by John A. Gruwell and me. We collected the allotype the following day, 20 miles N. of El Rodeo, Baja California Norte. Data about paratypes (27) are presented in the appendix.

Diagnosis. – The black dorsum and shiny pronotum with its shallow, transversely confluent foveae, nearly obliterated median groove, and deep postocular emarginations (Fig. 125B) serve as diagnostic characteristics for *O. gruwelli.* Externally, adults of *O. gruwelli* are very similar to those of *O. arizonicus.* The male genitalia of the two species are quite distinct, and, together with the allopatric distribution, readily distinguish the two. Refer to the diagnosis of *O. arizonicus* for further comparisons.

Description. – *Form:* Ovate, moderately convex (Fig. 125B). *Size:* Holotype 1.84 mm long, 0.84 mm wide. *Color:* Dorsum and venter black; legs and palpi brown. *Head:* Length 0.34 mm; width 0.50 mm. Frons with moderately large punctures, separation one-three times puncture diameter, surface shining with very sparse, fine hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi moderately large; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with moderately large punctures in midline, separation one-three times puncture diameter; lateral areas with microreticulation in addition to punctures. Labroclypeal suture straight. Labrum length 0.33 width; surface with small punctures and dense hairs; median emargination of moderate depth and width, depth 0.33 length of labrum, width 0.25 width of labrum, sides of emargination upturned slightly. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 nearly 0.50 length of 3. Mentum width equal length, moderately shining, with small punctures; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.42 mm; maximum width (near anterior 0.33) 0.62 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near midlength of lateral depression, extended straight to posterior angles, very narrow around posterior margin. Anterior margin of pronotum shallowly bisinuate, lacking crenulations in front of each lateral depression; anterior angles acute. Lateral depressions slightly convex, with small punctures, microreticulation and small indistinct hairs; margins moderately arcuate, with a small tooth at base of lateral depression; pronotum moderately constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapering into tooth at lateral hyaline border. Pronotal disc moderately convex, punctures moderately small, separated by one-five times puncture diameter; with fine, very sparse hairs; surfaces between punctures flat, smooth, and shiny. Median groove nearly obsolete in middle of disc, reduced to narrow, shallow channel, anterior and posterior extremes more developed, microreticulate in addition to small punctures. Anterior foveae moderately deep, narrow and elongate, connected to median groove by shallow depression. Posterior foveae elongate and narrow, connected to median groove by shallow depression; surface sculpture as in median groove. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 1.20 mm; maximum width (near midlength) 0.84 mm. Disc flat, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33. most punctures somewhat elongate; intervals flat, width 1.5 puncture width, with fine impressed lines; interstices between punctures 0.50 puncture length; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 2.0:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 126C)(8 exmained).

Variation. – Specimens from Baja California frequently have the pronotal sculpture more deeply impressed than specimens from further north, but this difference is very slight. The aedeagi of northernmost known males, from Los Angeles County, are virtually identical to those of specimens from Baja California.

Natural History. – *O. gruwelli* has been collected at the margins of both streams and ponds. Some details of this species' microhabitat preferences are presented by Perkins (1976) under the name *O. lineatus.*

Distribution. – (Figs. 127B,180). Coastal mountains of southern California and northern Baja California.

Etymology. – I take pleasure in dedicating this species to my good friend and fellow aquatic Coleopterist, John A. Gruwell, who initiated my interest in water beetles.

30. *Ochthebius arizonicus* new species
(Figs. 126D,127B,180)

Type-locality. – 19 mi. N. Roosevelt, Sycamore Creek, Gila County, Arizona, U.S.A.

Type-specimens. – The holotype male and allotype with identical data are deposited in USNM. Joe Schuh collected these specimens April 6, 1966. Data about paratypes (17) are presented in the appendix.

Diagnosis. – Externally, adults are very similar to those of *O. gruwelli.* The latter species, however, is from southern California and adjacent Baja California. The male genitalia of the two species (Figs. 126C,D) are quite distinct. The aedeagus of *O. gruwelli* has the apical piece strongly arcuate, with the thin margin wide, whereas the apical piece of *O. arizonicus* is not arcuate and has the thin margin quite narrow. Additionally, the apex of the main-piece is narrower and much more acute in *O. arizonicus.*

Description. – *Form:* Ovate, moderately convex (Fig. 125B). *Size:* Holotype 1.88 mm long, 0.84 mm wide. *Color:* Dorsum and venter black; legs and palpi brown. *Head:* Length 0.34 mm; width 0.50 mm. Frons finely punctate; interocular foveae moderately deep, width of each equal to distance between them; interocular tuberculi large; basomedial fovea nearly as deep and as large as interocular foveae. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, finely punctate. Labroclypeal suture straight. Labrum length 0.33 width, finely punctate, finely pubescent; median emargination very small, edge upturned very slightly. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 slightly greater than 0.50 length of 3. Mentum width equal length, shining, finely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (near anterior 0.33) 0.62 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near midlength of lateral depression, extended straight to posterior angles, very narrow around posterior margin. Anterior margin of pronotum straight, postocular emarginations well developed, postocular processes absent. Lateral depressions flat, densely, coarsely punctate, finely pubescent; margins moderately arcuate; pronotum moderately constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, microreticulate, moderately coarsely punctate; inner margin moderately abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, finely, sparsely punctate. Median groove absent. Anterior foveae small, shallow, joined by very shallow, transverse depression. Posterior foveae moderately deep and large, joined by very shallow, transverse depression. Posterolateral angles with with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 1.20 mm; maximum width (near midlength) 0.84 mm. Disc moderately convex, moderately dull, with six rows of punctures between suture and humeri. Declivity origin near posterior 0.33. Intervals flat, width equal puncture width, with fine impressed lines. Interstices between punctures 0.50 puncture length. Each puncture with seta. Explanate margin slightly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.9:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 126D)(8 examined).

Variation. – The series from which the holotype was selected exhibits considerable variation in depth of the pronotal impressions. At one extreme the foveae are shallowly impressed and the median groove is absent. At the other extreme the foveae are deeper and joined by a narrow, longitudinal groove; shallow, transverse depressions joining the foveae of opposite sides are deeper, and there is a very shallow median groove.

Distribution. – (Figs. 127B,180). Eastern Arizona.

Etymology. – *arizonicus*, in reference to the geographical distribution.

31. *Ochthebius madrensis* new species
(Figs. 125E,127A,131B,180)

Type-locality. – Southwest Research Station, Portal, Cochise County, Arizona, U.S.A.

Type-specimens. – The holotype male and allotype with identical locality data are in USNM. These specimens were collected by W.E. Steiner May 14, 1976. Data about paratypes (11) are presented in the appendix.

Diagnosis. – Black color, shiny pronotum with shallow postocular emarginations and confluent foveae (Fig. 125E), and male genitalia are diagnostic for this species.

Description. – *Form:* Ovate, moderately convex (Fig. 125E). *Size:* Holotype 1.72 mm long, 0.80 mm wide. *Color:* Dorsum and venter black; legs and palpi brown. *Head:* Length 0.34 mm; width 0.42 mm. Frons with moderately large punctures, separation one-three times puncture diameter, surface moderately shining, with obvious hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi moderately large; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with moderately large punctures in midline, separation one-three times puncture diameter; lateral areas with microreticulation in addition to punctures; with obvious hairs. Labroclypeal suture straight. Labrum length nearly 0.50 width; surface with small punctures and dense hairs; median emargination moderately deep and wide, depth 0.33 length of labrum, width 0.25 width of labrum, sides of emargination slightly upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, moderately shining, with small punctures; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near anterior 0.33) 0.56 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near midlength of lateral depression, extended straight to posterior angles, very narrow around posterior margin. Anterior margin of pronotum shallowly bisinuate, without crenulations in front of lateral fossulae and with excavation in front of each lateral depression; small tooth at median extreme of excavation slightly upturned; anterior angles acute. Lateral depressions flat, with microreticulation, moderately sized punctures and distinct hairs; margins moderately arcuate, with small tooth at base of lateral depression; pronotum moderately constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into tooth at lateral hyaline border. Pronotal disc moderately convex, punctures moderately small, separated by one-three times puncture diameter; with fine, sparse hairs; surfaces between punctures flat, smooth and shiny. Median groove reduced to very narrow and shallow groove not connected with confluent posterior foveae, but connected with shallow depression united to anterior foveae. Anterior foveae narrow and elongate. Posterior foveae elongate and narrow, connected by channel to anterior foveae; posterior extremes of posterior foveae united by well developed depression with punctation. United anterior and posterior foveae in form of sinuate line. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities, coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 1.12 mm; maximum width (near midlength) 0.80 mm. Disc flat, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; most punctures somewhat elongate, intervals flat, width 1.5 puncture diameter; interstices between punctures 0.50 puncture length; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, long hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.7:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 131B)(4 examined).

Variation. – Despite the distance separating the Arizona and Mexico populations (Fig. 127A), the male genitalia and external characteristics of the two groups are virtually identical.

Natural History. – My wife Maureen and I collected three specimens from the sandy margins of a stream flowing through a pine forest meadow in the mountains west of Durango, Mexico. One specimen from the Chiricahua mountains of Arizona was taken at an ultraviolet light.

Distribution. – (Figs. 127A,180). Known from southeastern Arizona and one locality in Durango, Mexico. Future collecting will probably reveal a general distribution throughout the Sierra Madre Occidental mountains.

Etymology. – *madrensis*, in reference to distribution in the Sierra Madre Occidental mountains.

32. *Ochthebius pauli* new species
(Figs. 125F,127A,129D,180)

Type-locality. – Nine miles SE El Tule, Oaxaca, Mexico.

Type-specimens. – The holotype male and one male paratype with same data are deposited in USNM. Paul J. Spangler collected these specimens August 24, 1965.

Diagnosis. – Adults are similar to those of *O. madrensis* in most respects, including shallow postocular emarginations, confluent posterior foveae, and black color. The elytra characteristic of *O. pauli*, however, have the punctures large and striate-impressed, the width of the rows being equal to or greater than the intervals, whereas in *O. madrensis* adults the serial punctures are small, not as wide as the intervals, and not striate-impressed. Additionally, the lateral depressions of the pronotum are more convex in *O. pauli*, and the aedeagus is different from that of *O. madrensis* (Figs. 129D,131B).

Description. – *Form:* Ovate, moderately convex (Fig. 125F). *Size:* Holotype 1.68 mm long, 0.80 mm wide. *Color:* Dorsum and venter black, legs and palpi dark brown. *Head:* Length 0.30 mm; width 0.42 mm. Frons moderately punctate, shiny except in microreticulate areas near eyes; pubescence moderately developed; interocular foveae well developed, width of each 0.66 distance between them; interocular tuberculi moderately large; basomedial fovea smaller than interocular foveae. Frontoclypeal suture slightly angulate. Clypeus shiny, length slightly less than 0.50 width, punctures in midline separated by two-three times puncture diameter; lateral areas more densely punctate, slightly microreticulate, moderately pubescent. Labroclypeal suture straight. Labrum length nearly 0.50 width, microreticulate, pubescent; median emargination well developed, depth 0.33 length of labrum, width 0.25 width of labrum; lobes formed by emargination at angle to remainder of labrum. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum quadrate, finely punctate; anterior margin arcuate to rear. Submentum evenly, finely punctulate. Genae shiny, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near anterior 0.33) 0.56 mm. Anterior hyaline border moderately wide in front of disc, twice this width in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near midlength of lateral depression, extended staight and slightly convergent to posterior angles, very narrow around posterior margin. Anterior margin of pronotum straight except small postocular emarginations; anterior angles acute. Lateral depressions slightly convex, moderately punctate and microreticulate; margins slightly arcuate; pronotum moderately constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, microreticulate. Pronotal disc moderately convex, punctures small, separated by one-three times puncture diameter, interstices shiny. Median groove narrow, united at posterior with confluent posterior foveae. Anterior foveae narrow, elongate, microreticulate, joined to median groove by very shallow, non-microreticulate depression. Posterior foveae narrow, elongate, microreticulate, united to median groove by microreticulate and punctate depression. Posterior angles with distinct impressions. Prosternum with median carina ended at coxal cavities, coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 1.04 mm; maximum width (near midlength) 0.80 mm. Disc slightly convex, with six rows of striate-impressed, relatively large punctures between suture and humeri. Intervals rounded, width less than that of punctures. Each puncture with seta. Explanate margin weakly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, long hairs. *Legs:* Moderately long and slender. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 129D)(2 examined).

Variation. – The posterior foveae of the single male paratype are not united to the median groove as they are in the holotype. The aedeagus of the paratype, however, is identical to that of the holotype.

Distribution. – (Figs. 127A,180). Presently known only from the type-locality near El Tule, Oaxaca, Mexico.

Etymology. – It is a pleasure to dedicate this species to Paul J. Spangler, my friend, mentor and colleague. He has collected the only known specimens of *O. pauli*, as well as the only known material of several other hydraenid species.

33. *Ochthebius mexcavatus* new species
(Figs. 125C,127A,128A-F,129E,180)

Type-locality. – Madicolous habitat, El Diablo, ca. 100 miles W. Durango, Mexico.

Type-specimens. – The holotype male and allotype with identical locality data are in USNM. My wife Maureen and I collected these specimens, July 18, 1974. Data about paratypes (135) are presented in the appendix.

Diagnosis. – Pronotal form, with very deep postocular emarginations and large, acute processes behind the lateral depressions (Figs. 125C,128A) serve as diagnostic characteristics for this very distinctive species.

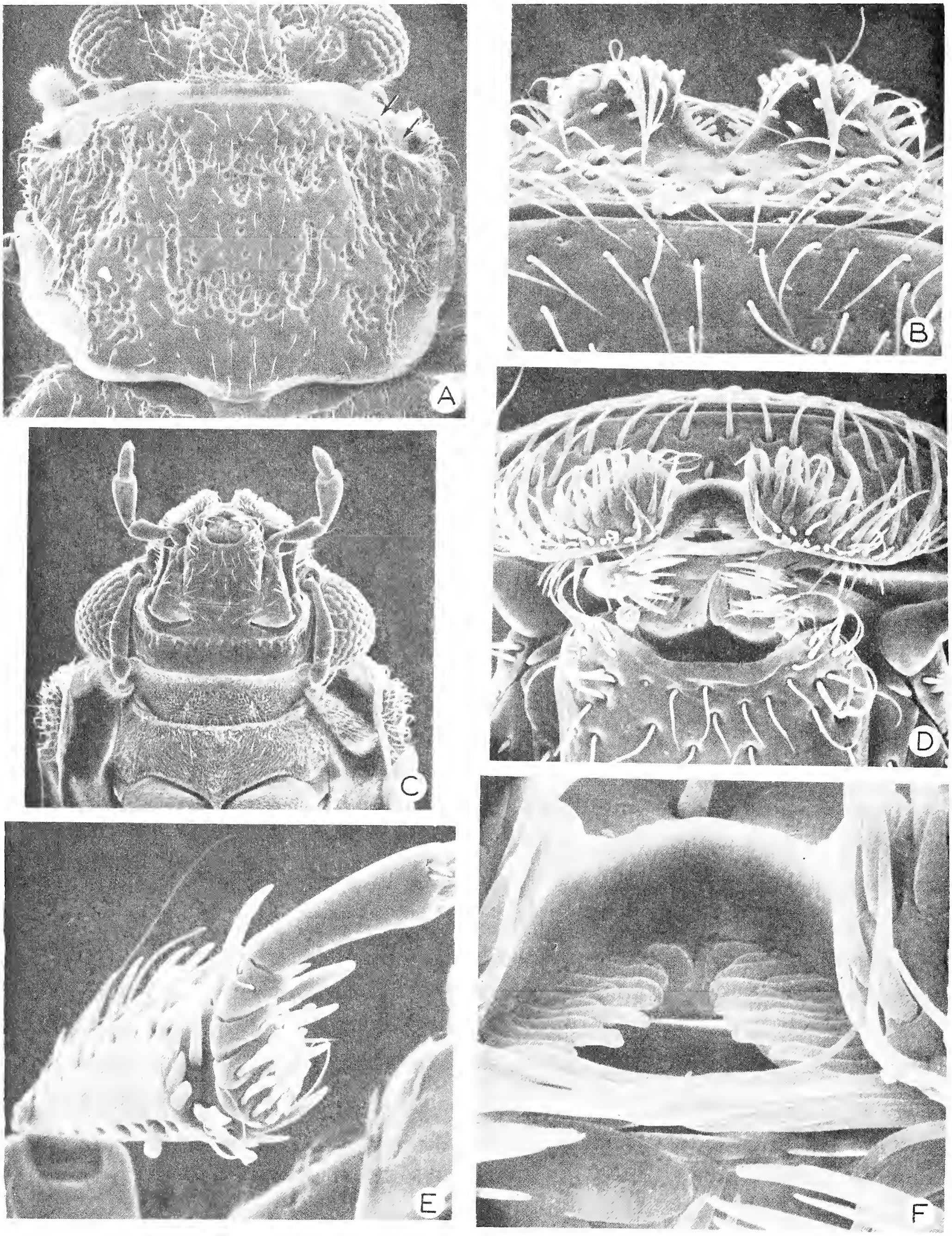
Description. – *Form:* Ovate, moderately convex (Fig. 125C). *Size:* Holotype 1.68 mm long, 0.80 mm wide. *Color:* Body uniformly dark brown, moderately reflective. *Head:* Length 0.32 mm; width 0.46 mm. Frons with moderately sized punctures, separation one-three times puncture diameter, surface moderately shining, with obvious hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi moderately large; basomedial fovea very small. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with small punctures, separation five times diameters; hairs quite prominent. Labroclypeal suture straight. Labrum length nearly 0.50 width; surface with small punctures and dense hairs; median emargination deep and wide, depth nearly 0.50 length of labrum, width 0.25 width of labrum, lobes markedly upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, moderately shining, with small punctures; anterior margin arcuate. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.42 mm. maximum width (near anterior 0.33) 0.60 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near midlength of lateral depression, extended straight to posterior angles, very narrow around posterior margin. Anterior margin of pronotum shallowly bisinuate, without crenulations in front of lateral fossulae and with very deep excavation in front of each lateral depression; small tooth at median extreme of excavation slightly upturned; anterior angles acute. Lateral depressions slightly convex, with moderate sized punctures, microreticulation, and small indistinct hairs; margins excavated in posterior 0.50, with pronounced tooth at base of excavation; pronotum moderately constricted behind lateral depressions. Lateral fossulae deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into tooth at lateral hyaline border. Pronotal disc convex, punctures small, separation three-five times puncture diameter; hairs not apparent; surfaces between punctures smooth and shiny; areas to each side of median groove slightly elevated and rounded. Median groove deep narrow channel in middle of disc, anterior and posterior extremes obliterated by confluent anterior and posterior foveae. Anterior foveae deep and confluent; lateral margin straight and nearly parallel to median groove. Posterior foveae somewhat triangular, with well developed microreticulation; lateral extreme ended abruptly as straight line slightly oblique to median groove; median extremes of foveae confluent. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 1.08 mm; maximum width (near midlength) 0.80 mm. Disc slightly convex, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; most punctures round; intervals rounded and slightly elevated, width equal to puncture diameter; interstices between punctures 0.25 puncture diameter; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, long hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.7:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 129E)(7 examined).

Variation. – The samples seen were quite homogeneous.

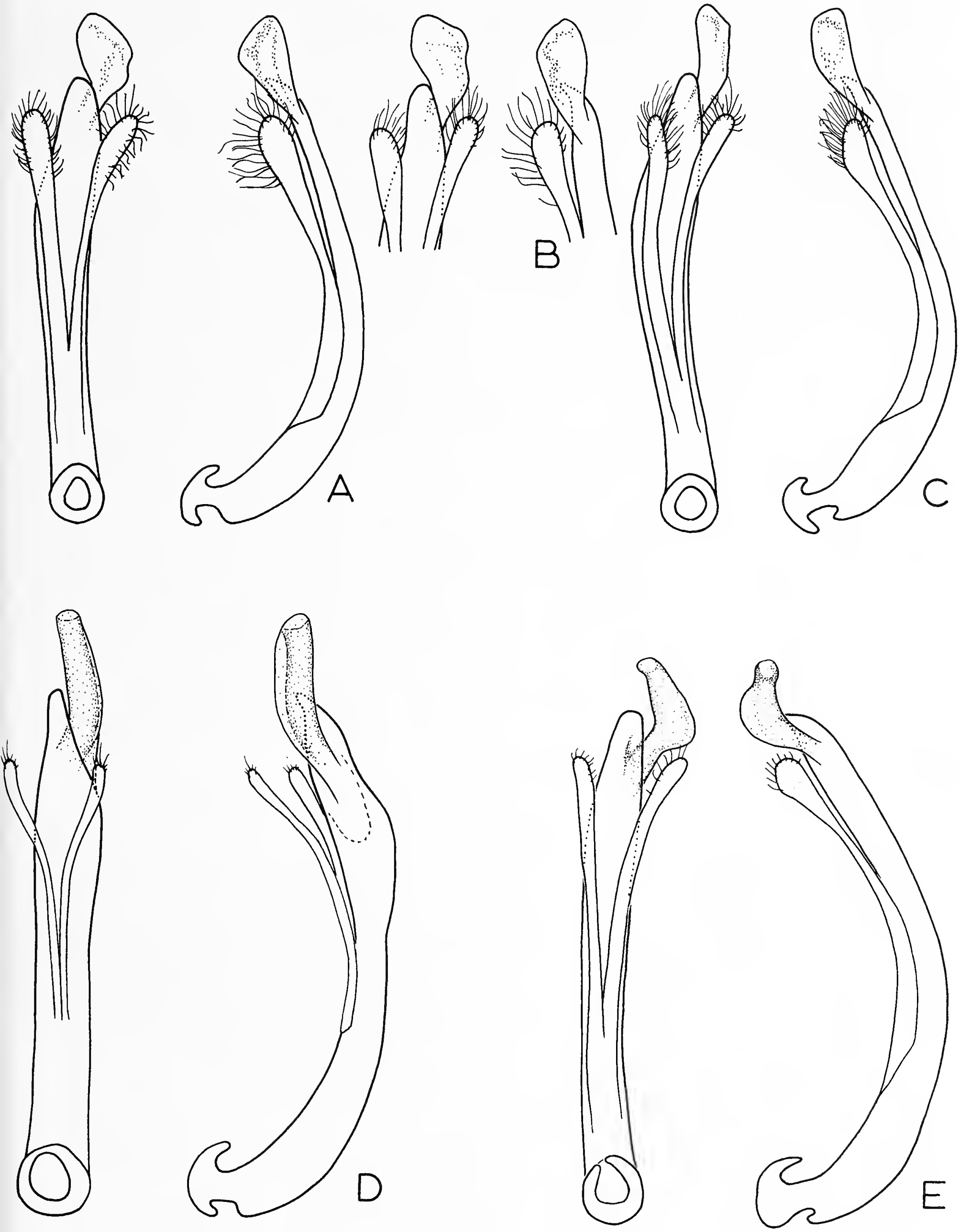
Natural History. – My wife Maureen and I collected 127 specimens from a hillside seepage area in the mountains west of Durango, Mexico. The south-facing slope consisted of large rock outcroppings, interspersed among grassy areas. The margins of each rock outcropping (where the grass met the rock) were covered with a thin layer of flowing water, from which the beetles were collected. Some specimens were taken by raising the grass and attached soil, to expose more of the wet rock surface. The habitat did not appear to be madicolous in the strict sense, that is, the slope of the hill was not as steep as usual in typical Central American madicolous habitats. Nevertheless, one specimen of the strictly madicolous hydrophilid *Oocyclus* was found on the seepage area.

Distribution. – (Figs. 127A,180). Sierra Madre Occidental mountains in the states of Sinaloa and Durango, Mexico.

Etymology. – *mexcavatus*, referring to distribution and pronotal form.



Figs. 128A – F, *Ochthebius mexcavatus*, ♂. (A) pronotum (arrows indicate postocular emargination and process). (B) labrum, dorsal view. (C) head ventral view. (D) labrum and mouthparts, anterior view. (E) prothoracic leg. (F) labral emargination and sensilla, anterior view.



Figs. 129A – E, Aedeagi of *Ochthebius* species. (A) *O. mesoamericanus*, holotype. (B) *O. mesoamericanus*, Durango, Mexico. (C) *O. mesoamericanus*, San Luis Potosi, Mexico. (D) *O. pauli*, holotype. (E) *O. mexcavatus*, holotype.

34. *Ochthebius obscurus* Sharp
(Figs. 10F,125A,126B,130,180)

Ochthebius obscurus Sharp, 1882:92 (lectotype male in BMNH, here designated; type-locality: Guanajuato, Mexico).

Diagnosis. – Black color, widely separated posterior foveae and absence of a median groove serve to distinguish this member of the *biincisus* Group.

Description. – *Form:* Ovate, moderately convex (Fig. 125A). *Color:* Dorsum and venter black. Legs, palpi and elytral epipleura brown. *Head:* Length 0.36 mm; width 0.52 mm. Frons shiny, finely moderately sparsely punctate, punctures with very fine hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi moderately large; basomedial fovea nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; punctures separated by one-three times puncture diameter, with fine hairs. Labroclypeal suture straight. Labrum length 0.50 width; anterior angles rounded; surface with small punctures and fine, dense hairs; median emargination shallow, edge upturned slightly. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 nearly 0.66 length of 3. Mentum width equal length, moderately shiny with sparse, small punctures; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near anterior 0.33) 0.66 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near midlength of lateral depression, extended straight to posterior angles, very narrow around posterior margin. Anterior margin of pronotum straight, without crenulations in front of lateral fossulae and with shallow excavation in front of each lateral depression; anterior angles acute. Lateral depressions flat, with moderate sized punctures, microreticulation and small hairs; margins slightly arcuate; tooth at posterior extreme of lateral depression; pronotum slightly constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, with well developed microreticulation; inner margin moderately abrupt, posterior extreme tapered into tooth at lateral hyaline border. Pronotal disc moderately convex, punctures moderately small and sparse, separated by one-three times puncture diameter; with fine, sparse hairs; surface between punctures smooth and very shiny. Median groove absent; a shallow, transverse depression at anterior and posterior. Anterior and posterior foveae narrow grooves united in form of sinuate line, anterior very shallow. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 1.28 mm; maximum width (near midlength) 0.88 mm; Disc slightly rounded, moderately shiny, with six rows of punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; most punctures slightly elongate; intervals flat, width twice puncture width; interstices between punctures 0.50 puncture length; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.7:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 126B)(2 examined); female (Fig. 10F)(3 examined).

Variation. – The two specimens from near Valle de Bravo, in the state of Mexico, differ remarkably from the lectotype and the two specimens from Hidalgo (see appendix for locality data). The former specimens are much smaller (1.72 vs 1.96 mm), more finely and sparsely punctate on the pronotum and head, and have the pronotal foveae much more deeply impressed. In addition, the postocular emarginations are slightly deeper. The aedeagus of the single male from the state of Mexico, however, is virtually identical to that of the lectotype (Fig. 126B), differing only in having the slender apex of the main-piece slightly shorter. I have studied a total of only six specimens in addition to the lectotype (see appendix).

Natural History. – The two specimens from the state of Mexico were taken from a stream containing an unusual abundance of leaf drift. This site is the type-locality of *Spanglerina ingens*(Fig. 197B). The two specimens from Hidalgo were at the sand-gravel margin of an intermittent desert stream; *Hydraena scintilla* was also found at this locality.

Distribution. – (Figs. 130,180) Presently known from the states of Guanajuato, Hidalgo and Mexico, Mexico.

Remarks. – The body outline illustration (Fig. 125A) is that of the male specimen from the state of Mexico.

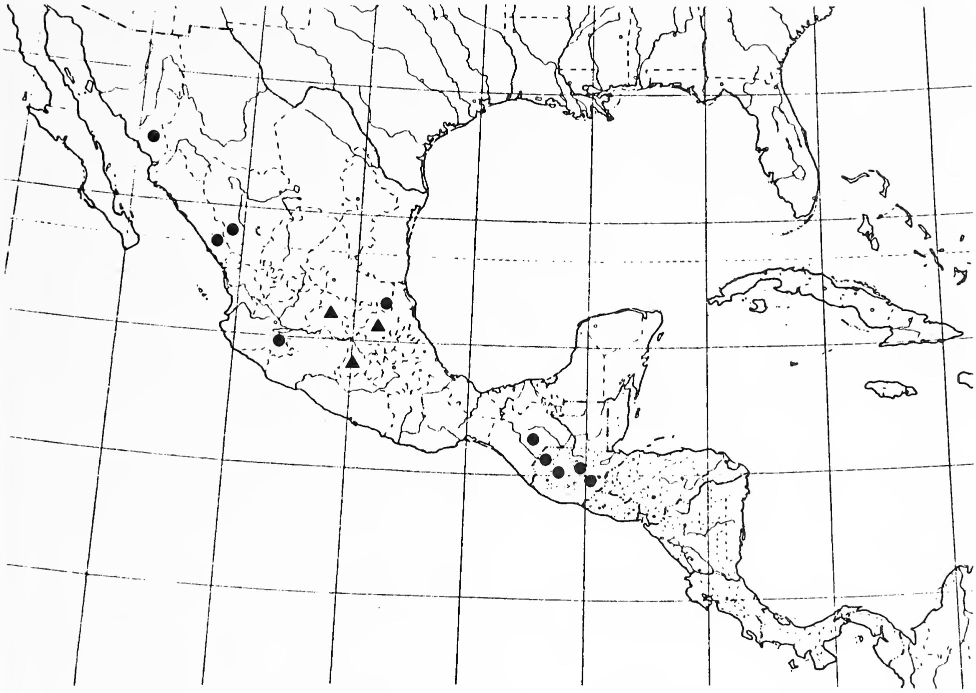


Fig. 130. Geographical distributions of *Ochthebius mesoamericanus* ● and *O. obscurus* ▲.

35. *Ochthebius mesoamericanus* new species
(Figs. 119E,129A-C,130,180)

Type-locality. – Small pool at base of waterfall, 45 miles E. of Jalapa, Jalapa, Guatemala.

Type-specimens. – The holotype male and allotype with identical locality data are in USNM. My wife Maureen and I collected these specimens, June 14, 1974. Data about paratypes (85) are presented in the appendix.

Diagnosis. – Small size, dull pronotum with broadly confluent posterior foveae forming a U-shaped depression, nearly obliterated median groove, and deeply emarginate labrum (Fig. 119E) serve to characterize adults of this distinctive species.

Description. – *Form:* Ovate, moderately convex (Fig. 119E). *Size:* Holotype 1.60 mm long, 0.68 mm wide. *Color:* Dorsum and venter dark brown; legs and palpi brown. *Head:* Length 0.30 mm; width 0.40 mm. Frons finely, densely punctate, microreticulation well developed, especially laterally; with very fine hairs; interocular foveae deep and large, width of each nearly equal to distance between them; interocular tuberculi large; basomedial fovea nearly as deep and as large as interocular foveae. Frontoclypeal suture evenly arcuate. Clypeus length 0.60 width; finely densely punctate, microreticulate and with fine hairs. Labroclypeal suture straight. Labrum length 0.33 width; surface with microreticulation and fine dense hairs; median emargination large, U-shaped, depth 0.50 length of labrum, width 0.25 width of labrum; lobes upturned. Maxillary palpus with palpomere 3 moderately wide; ultimate segment 0.50 length of 3. Mentum longer than wide, anterior margin deeply emarginate, surface shiny and with small punctures. Submentum evenly, finely punctulate, punctures contiguous. Genae shining swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.34 mm; maximum width (near anterior 0.33) 0.50 mm. Anterior hyaline border moderately narrow in front of disc, wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near

midlength of lateral depression, extended straight to posterior angles, very narrow around posterior margin. Anterior margin of pronotum slightly bisinuate, without crenulations in front of each lateral fossula; small excavation in front of each lateral depression; anterior angles acute. Lateral depressions flat, with well developed microreticulation and small hairs; small tooth at posterior extreme; margins slightly arcuate; pronotum slightly constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into tooth at lateral hyaline border. Pronotal disc moderately convex, punctures in interfoveal area moderately small, separated by one-two times puncture diameter; with fine, sparse hairs; surface between punctures smooth and shiny. Anterior foveae broadly confluent in form of transverse depression with well developed microreticulation. Posterior foveae broadly confluent in form of deep U-shaped depression with well developed microreticulation. Median groove narrow and shallow, connected to confluent anterior and posterior foveae. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 0.96 mm; maximum width (near midlength) 0.68 mm. Disc flat, moderately shiny, with six rows of punctures between suture and humeri. Sides convex, declivity beginning near posterior 0.33; punctures round; intervals flat, width equal puncture width, with fine impressed lines; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin weakly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.7:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Figs. 129A-C)(17 examined).

Variation. – The male genitalia (Figs. 129A-C) shows considerable variation in shape of the apical piece. Externally adults are rather homogeneous throughout the range of this species, except for color; specimens from northern Mexico are generally much lighter than those from Guatemala.

Natural History. – Within lotic habitats, this species appears to have a rather wide ecological tolerance, as specimens have been found in "small pool at base of waterfall", "small, rapid stream", "tropical brook", "stream in pine forest", and "somewhat muddy stream". I collected a large series (50 specimens) from hard-packed gravel at the margin of a stream flowing through a pine forest meadow in the mountains west of Durango, Mexico.

Distribution. – (Figs. 130,180). Known from the state of Sonora in northwest Mexico south to Guatemala. Further collecting will probably reveal a widespread distribution throughout the mountainous areas of Mexico and Central America.

Etymology. – *mesoamericanus*, in reference to the geographical distribution.

The *benefossus* Group

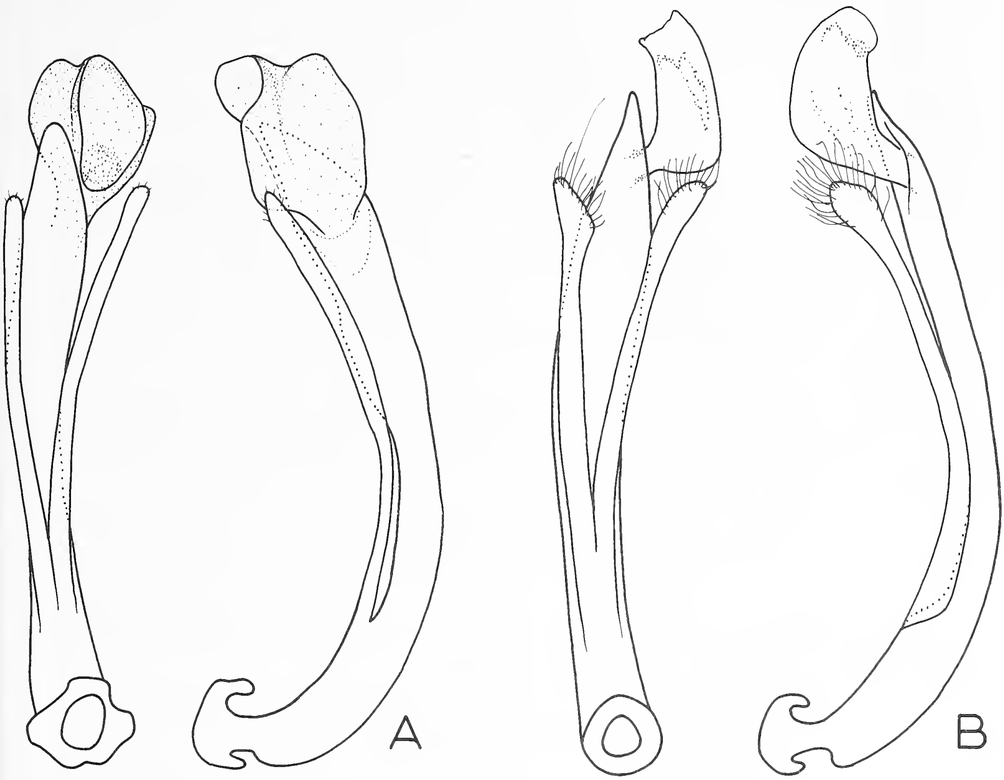
As commented upon in the discussion section of the genus, *O. benefossus* was formerly placed in the subgenus *Henicocerus*, which is herein not considered of equal rank with *Asiobates* and *Ochthebius (sensu stricto)*. However, by the pronotal form (Figs. 96D,132B), *O. benefossus* is clearly a member of the *Henicocerus* lineage, and should be included in any consideration of the phylogeny of that group. In addition to the unusual pronotum, the aedeagus is unique among Western Hemisphere *Ochthebius* in shape of the apical mobile piece, which is subtriangular in cross-section (Fig. 131A).

36. *Ochthebius benefossus* LeConte
(Figs. 10E,96D,99C,131A,132B)

Ochthebius benefossus LeConte, 1878:381 (holotype female in MCZ; type-locality: New Jersey, U.S.A.). – Horn, 1890:19.

The holotype is in poor condition, without the following structures: left elytron, all of left hind leg except coxa, left middle tarsus, and left front tibia and tarsus.

Diagnosis. – Pronotal form (Figs. 96D,132B) with flat lateral depressions, convex disc, interrupted median groove, and narrow lateral hyaline borders within the posterior sinuations serve as diagnostic characteristics for adults of this distinctive species.



Figs. 131A – B, Aedeagi of *Ochthebius* species. (A) *O. benefossus*, specimen from Bennington County, Vermont. (B) *O. madrensis*, holotype.

Description. – *Form:* Ovate, convex (Fig. 132B). *Size:* Holotype 1.64 mm long, 0.80 mm wide. *Color:* Dorsum black; venter dark brown; legs and palpi brown. *Head:* Length 0.32 mm; width 0.42 mm. Frons punctures separated by puncture diameter in midline, closer laterally; with very fine hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi moderately large; basomedial fovea ill-defined. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with punctation as frons, and fine hairs. Labroclypeal suture straight. Labrum length 0.50 width; surface with small punctures and fine hairs; median emargination small, U-shaped; length 0.25 length of labrum; width 0.20 labral width; lobes evenly rounded, not upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.33 length of 3. Mentum width equal length, shining, with microreticulation and small punctures; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.42 mm; maximum width (near anterior 0.33) 0.52 mm. Anterior hyaline border narrow. Lateral hyaline border origin at posterior extreme of lateral depression, very narrow, continuing straight to posterior angles, extremely narrow around posterior margin. Anterior margin of pronotum bisinuate, with small tooth in front of lateral fossulae; shallow, broad excavation in front of each lateral depression; anterior angles obtuse. Lateral depressions flat, broad and relatively short, occupying 0.66 length of pronotum; margin irregular; internal area very smooth and shiny; margins arcuate; pronotum moderately constricted behind lateral depressions. Lateral fossulae deeply impressed, smooth; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc very convex, punctures in interfoveal area deeply impressed, moderately large, separated by puncture diameter or less; surface

between punctures smooth and shiny. Median groove very broad anteriorly, tapered posteriorly, posterior extreme separated from transverse depression, latter joined to posterior foveae. Posterior foveae very deeply impressed, oblique ovals. Anterior foveae deeply impressed, circular, joined to median groove by depression. All depressions with microreticulation and irregular punctation. Posterolateral angles with distinct impressions. Prosternum with shallow transverse depression along entire anterior margin; median carina ended at coxal cavities; coxae contiguous. Metasternum without median glabrous area. *Elytra:* Length 1.00 mm; maximum width (near midlength) 0.80 mm. Disc convex, shiny, with six rows of punctures between suture and humeri. Sides convex, declivity origin slightly past midlength; punctures round; intervals flat, width equal puncture width; interstices between punctures 0.25 puncture diameter; each puncture with very small seta. Explanate margin well developed, extended entire length of elytron. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Somewhat short and stout; ratio of hind leg length to abdominal length 1.3:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Fig. 131A)(2 examined); female (Fig. 10E).

Variation. – Specimens studied (39, see appendix) are quite homogeneous. Males are differentiated from females by shape of labrum, which in the former has the emargination smaller and its edge deflexed slightly.

Natural History. – Locality data give no indication of habitat preferences other than the citation, "in wet Hypnum moss".

Distribution. – (Fig. 99C). Northeastern North America from Quebec south to Virginia and west to Indiana.

Remarks. – I have seen one specimen supposedly form Dunedin, Florida (W.S. Blatchley, collector). This locality is far south of the general distribution and I believe that the label data is incorrect.

The Subgenus *Ochthebius (Asiobates)*

As is described in the key to the subgenera, *Ochthebius (Asiobates)* is distinguished from the nominate subgenus by pronotal and aedeagal differences.

The *discretus* Group

Members of this lineage are characterized by small to medium size (ca. 1.60-2.20 mm long) and aedeagal form, which has the terminal mobile piece with a process (*mexicanus* is an exception) and the main-piece (in dorsal view) widest at its distal end, hence terminated abruptly (Figs. 141A-D). Additionally, the parameres are positioned in the same plane, side by side.

Externally this group is quite diverse, morphological variation involving convexity, sculpture, body shape, and loss of pronotal foveae.

The group has both temperate and tropical elements (Figs. 186-188); the five species of the *reticulocostus* Subgroup found in Mexico live at relatively high elevations, perhaps reflecting the temperate preferences of the group as a whole.

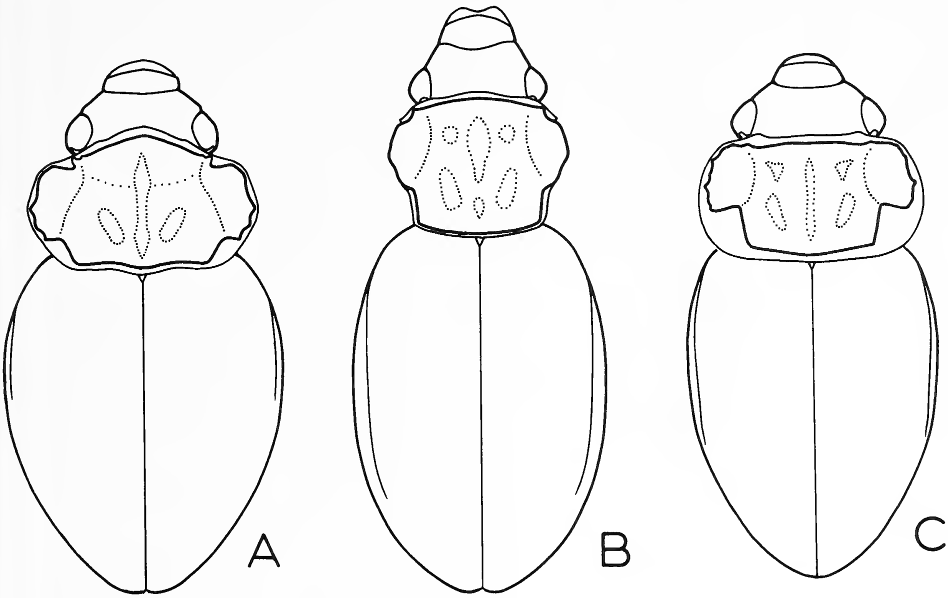
The morphological gap separating species of the *reticulocostus* Subgroup is rather pronounced, suggesting that other species await discovery.

The *discretus* Subgroup

Members of this subgroup are characterized by well developed anterior and posterior

pronotal foveae.

Four of the five included species are found in western North America (Fig. 186), one (*discretus*) being widely distributed and commonly collected, the other three (*mimicus*, *hibernus* and *orbus*) being very rare. The fifth species (*putnamensis*) is known only from Indiana.



Figs. 132A – C, *Ochthebius* body outlines. (A) *O. apicalis*. (B) *O. benefossus*. (C) *O. hibernus*.

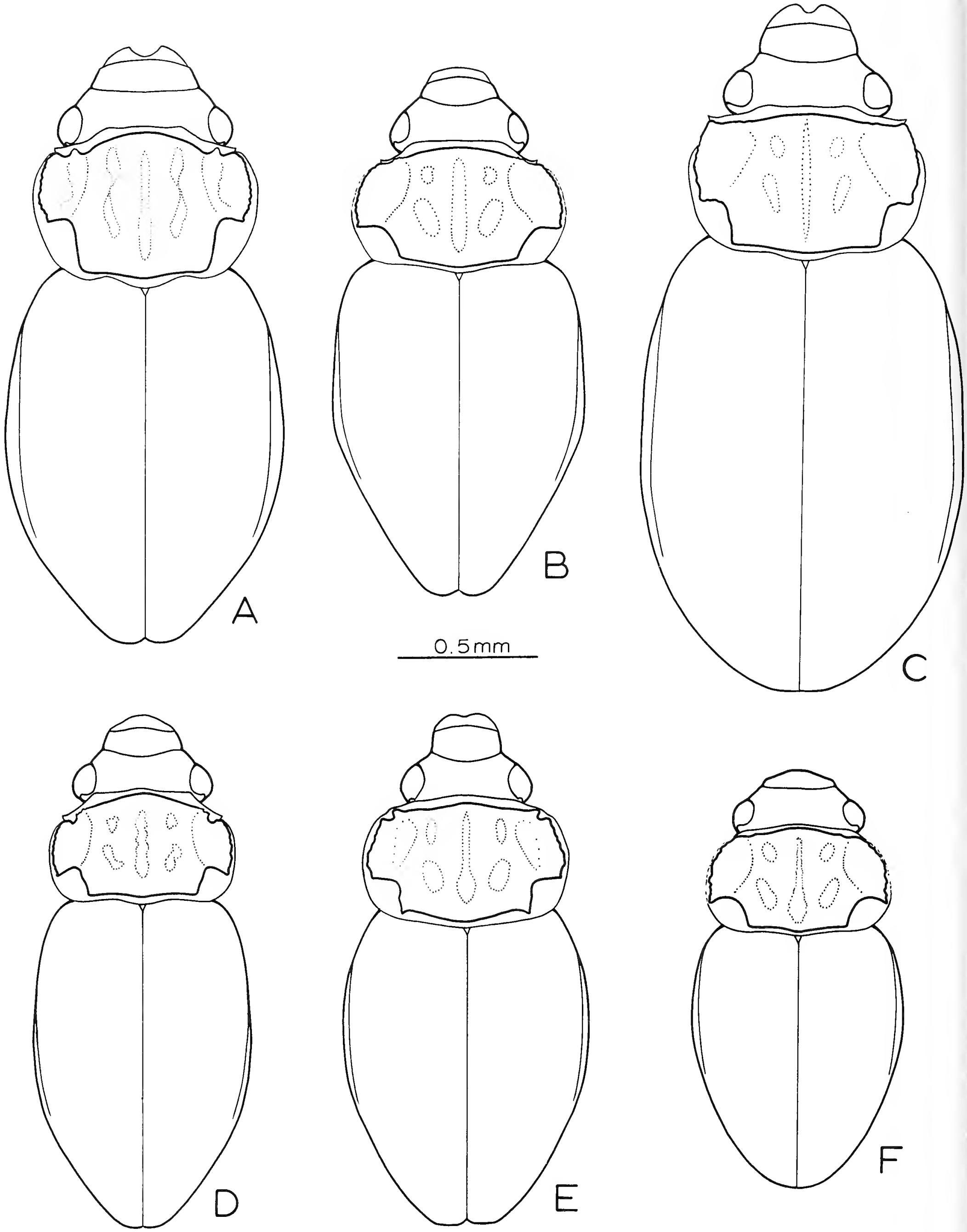
37. *Ochthebius discretus* LeConte
(Figs. 96E,133D,134A,B,135A,186)

Ochthebius discretus LeConte, 1878:379 (lectotype male in MCZ, here designated; type-locality: San Diego, California, U.S.A.). – Horn, 1890:21. – Fall, 1901:213. – Brown, 1931:117. – Brown, 1933:45. – Leech and Chandler, 1956:333. – Hatch, 1965:19. – Perkins, 1976:316.

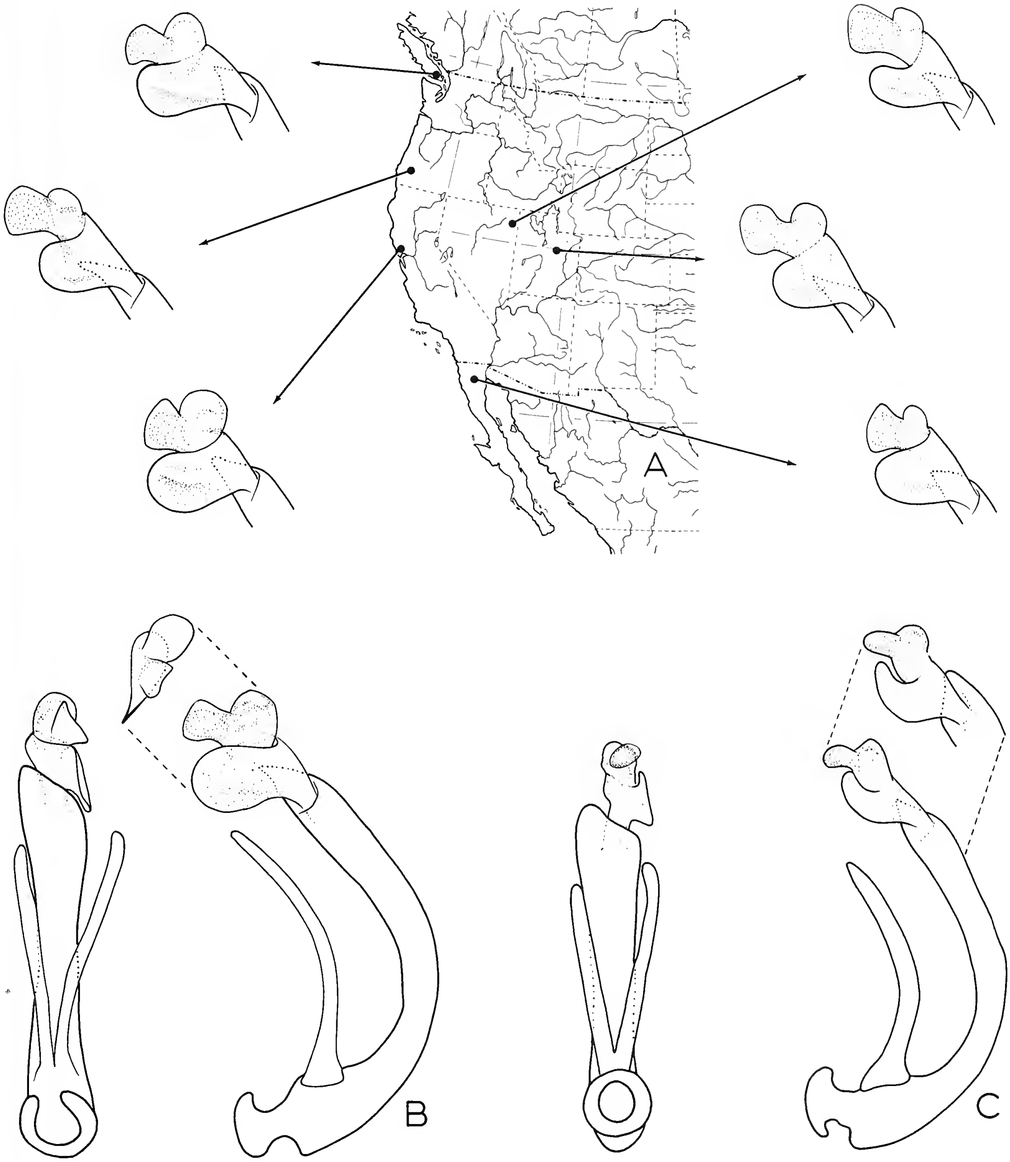
Ochthebius insulanus Brown, 1931:117 (holotype male in CNC; type-locality: Victoria, Vancouver Island, British Columbia, Canada; new synonomy).

The type-series in the LeConte collection at the MCZ consists of five specimens, two of which are *O. rectus* LeConte. The first two specimens are females. The third specimen, a male, is lectotype. The male genitalia, in a microvial attached to the pin, are of the variant illustrated from Baja California (Fig. 134A). The holotype of *O. insulanus* has the aedeagus of the form illustrated (Fig. 134A) from Vancouver Island, British Columbia.

Diagnosis. – Adults of this widespread, common species with black integument can be confused with the rare *O. mimicus* and *O. orbus*. *O. mimicus* adults are brown, more convex, with lateral depressions shaped differently, and with posterior pronotal angles produced as



Figs. 133A – F, *Ochthebius* body outlines. (A) *O. puncticollis*. (B) *O. orbus*. (C) *O. leechi*. (D) *O. discretus*. (E) *O. mimicus*. (F) *O. putnamensis*.



Figs. 134A – C, Aedeagi of *Ochthebius* species. (A) *O. discretus*, aedeagal apex variation. (B) *O. discretus*, Sonoma County, California. (C) *O. hibernus*, holotype.

points instead of angulate. *O. orbus* adults are brown, more convex, with lateral pronotal depressions less concave at rear and less markedly punctate (Figs. 96E,132C,133B,D). The male genitalia of the three species also differ (Figs. 134A-C,141B).

Description. – *Form:* Ovate, weakly convex (Fig. 133D). *Size:* Lectotype 1.80 mm long, 0.84 mm wide. *Color:* Dorsum and venter black; legs, palpi and antennae brown. *Head:* Length 0.32 mm; width 0.48 mm. Frons moderately coarsely to moderately densely punctate, microreticulate laterally, finely pubescent; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large, basomedial fovea nearly as deep and as large as interocular foveae. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; sculpture as lateral areas of frons. Labroclypeal suture straight. Labrum length 0.33 width, microreticulate, densely pubescent; median emargination present, forming bilobed anterior. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, finely, moderately densely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (near anterior 0.33) 0.64 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin at anterior angles, extended very narrowly along lateral depressions, wide at excavation, very narrow around posterior margin. Anterior margin of pronotum very slightly produced in middle 0.25, with small excavation in front of each lateral depression; anterior angles obtuse. Lateral depressions flat, slightly inflated, broad, coarsely densely punctate, finely pubescent; margins moderately arcuate, excavate at rear, small tooth lateral to excavation; pronotum markedly constricted behind lateral depressions. Lateral fossulae deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, coarsely densely punctate, punctures separated by thin walls to twice puncture diameter; with fine, sparse hairs; surface between punctures smooth and shiny. Median groove deep and wide, very slightly constricted in middle 0.33. Anterior foveae deep and large, microreticulate, width equal to distance between fovea and median groove. Posterior foveae deep and large, microreticulate. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.20 mm; maximum width (near midlength) 0.84 mm. Disc slightly convex, with depression in midregion, moderately shiny, with six rows of punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; punctures round, intervals rounded, very slightly elevated, width equal puncture width, with fine impressed lines; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin slightly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.6:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Figs. 134A,B)(133 examined).

Variation. – Specimens studied ranged from 1.68 mm to 2.20 mm in length. Some individuals have the elytra more distinctly striate than others. Pronotal punctation varies slightly in density and coarseness. Variation in the aedeagus primarily involves the relative sizes of the middle and basal lobes of the apical piece; I have illustrated the principal variants (Figs. 134A,B); no external variations correlating with these variants were noted. I examined 922 specimens (see appendix).

Natural History. – Many habitat descriptors (see appendix) mention "stream" or "river", less frequently "lake" or "pool". Other, more unusual, descriptors include: "margin of Typha pool", "pool in dry stream bed", "roadside marsh", "bog", "Hot Creek (it was cold)", "seepage trickle over gravelly soil", and "clear water pools in gravel and stones of otherwise dry and shaded creek bed". There is no indication of halophilic or thermophilic tendencies in *O. discretus*.

Distribution. – (Figs. 135A,186). Western North America from Aklavik, Northwest Territories south to Baja California and east to Colorado. Very common in California, but not yet found in the Death Valley region.

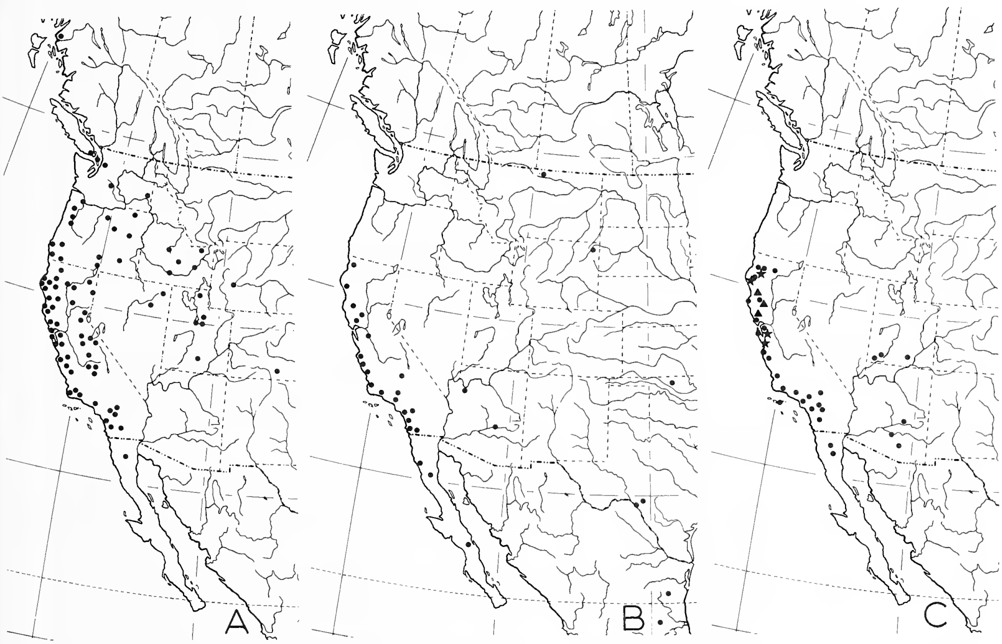
Remarks. – The large number of specimens available has permitted a detailing of genitalic variation, thereby allowing closely related *O. orbus* to be discriminated as a distinct species, and not a variant of *O. discretus*.

38. *Ochthebius hibernus* new species
(Figs. 132C,134C,186)

Type-locality. – Oregon, U.S.A.

Type-specimens. – The holotype male is deposited in USNM. The collector is unknown. One paratype male from Reindeer Depot, Mackenzie Delta, Northwest Territories, is deposited in CNC.

Diagnosis. – Small size, brown color, convex form, pronotum with smooth, finely punctate reliefs, rather wide lateral hyaline borders along the lateral depressions, and male genitalia are the salient features of adults of *O. hibernus*. Adults are similar to those of *O. mimicus* and *O. orbus*, but differ in pronotal form (Figs. 132C,133B,E), especially the short lateral depressions.



Figs. 135A – C, Geographical distributions of *Ochthebius* species. (A) *O. discretus*. (B) *O. tubus*. (C) *O. puncticollis* ●, *O. martini* ★ and *O. leechi* ▲.

Description. – *Form:* Ovate, convex (Fig. 132C). *Size:* Holotype 1.52 mm long, 0.74 mm wide. *Color:* Brown, head and pronotum darker than remainder. *Head:* Length 0.30 mm; width 0.46 mm. Frons sparsely finely punctate; interocular foveae deep and large, width of each 0.66 distance between them; interocular tuberculi moderately large; basomedial fovea smaller and shallower than interocular foveae. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, finely sparsely punctate. Labroclypeal suture straight. Labrum length 0.33 width, finely sparsely punctate. Labroclypeal suture straight. Labrum length 0.33 width, finely punctate, finely sparsely pubescent; median emargination slightly developed, edge slightly upturned. Maxillary palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, sparsely finely pnctate, anterior margin arcuate. Submentum finely punctulate. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near anterior 0.33) 0.66 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin at anterior angles, rather wide along lateral depressions, wide in region of excavations, very narrow around posterior margin. Anterior margin of pronotum straight, postocular processes very small, postocular emarginations absent. Lateral depressions impunctate and inflated medially; finely punctate laterally; length of lateral depressions very slightly more than 0.50 that of pronotum; latter markedly constricted behind lateral depressions. Lateral fossulae deeply impressed, withou apparent microreticulation; inner margin abrupt, posterior extreme tapered into

lateral hyaline border. Pronotal disc very convex, punctures in convex interfoveal areas fine and sparse; surface between punctures smooth and shiny. Median groove narrow, moderately deep. Anterior foveae deep, moderately large, subtriangular; width slightly less than distance between them and median groove. Posterior foveae deep, elongate. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.00 mm; maximum width (near midlength) 0.74 mm. Disc convex, shining, with six rows of punctures between suture and humeri. Sides very convex. Declivity origin near posterior 0.33. Intervals rounded, not elevated, width slightly greater than puncture width; interstices between punctures equal puncture diameter; each puncture with extremely fine, short seta. Explanate margin weakly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and stout; ratio of hind leg length to abdominal length 1.7:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 134C)(2 examined); female unknown.

Variation. – The one male paratype is much larger than the holotype (1.76 mm long and 0.88 mm wide) and darker, the color differences resulting from tenerality of the holotype. External and genitalic characters agree very well with those of the holotype, however.

Natural History. – The paratype from Reindeer Depot, Northwest Territories represents the northernmost known locality of a hydraenid beetle in the Western Hemisphere. This distribution indicates that *O. hibernus* is one of the species better adapted to cold climates.

Distribution. – (Fig. 186). Known from one male specimen supposedly collected in Oregon (site unspecified) and one male from Reindeer Depot, Northwest Territories.

Etymology. – Latin, *hibernus* (of winter). Named in reference to the cold climate of the region this species inhabits.

39. *Ochthebius orbus* new species
(Figs. 133B,139B,141B,186)

Type-locality. – Redwood Creek at Highway 1, Marin County California, U.S.A.

Type-specimens. – The holotype male is deposited in USNM. I collected this specimen October 24, 1971. The allotype and one female paratype (USNM) are from Portland, Multnomah County, Oregon; Hubbard and Schwarz collectors.

Diagnosis. – Adults are most similar to those of *O. discretus* and *O. mimicus*, differing from the former in color (brown instead of black), and in the shape of the lateral pronotal depressions. Adults of *O. orbus* differ from those of *O. mimicus* in larger size and lack of the produced posterior angles of the pronotum. In addition, male genitalia of the three species differ (Figs. 134A-C,141B). Refer to the diagnosis of *O. hibernus* for additional comments.

Description. – *Form:* Ovate, convex (Fig. 133B). *Size:* Holotype 1.96 mm long, 0.96 mm wide. *Color:* Dorsum and venter dark red-brown; legs, palpi and antennae testaceous. *Head:* Length 0.36 mm; width 0.50 mm. Frons sparsely, finely punctate; interocular foveae deep and large, width of each equal to distance between them; interocular tuberculi large, basomedial fovea smaller and shallower than interocular foveae. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, shiny, finely sparsely punctate, finely microreticulate. Labroclypeal suture straight. Labrum length 0.33 width, finely microreticulate, finely pubescent; median emargination slightly developed. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, sparsely, moderately finely punctate, anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.50 mm; maximum width (near anterior 0.33) 0.76 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin at anterior angles, extended very narrowly along lateral depressions, wide in region of excavation, very narrow around posterior margin. Anterior margin of pronotum straight, very small excavation in front of each lateral depression; anterior angles obtuse. Lateral depressions slightly inflated, broad, shiny, coarsely sparsely punctate, very sparsely pubescent; margins moderately arcuate, very deeply excavate at posterior, with small tooth lateral to excavation; pronotum markedly constricted behind lateral depressions. Lateral fossulae deeply impressed, shiny, without microreticulation; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc markedly convex, punctures in interfoveal area moderately large, separated by 0.5-1.0 times puncture diameter; apparently non-pubescent; surface between punctures smooth and shiny. Median groove moderately deep and wide, slightly wider in posterior 0.25, microreticulate. Anterior foveae deep and large; width equal to distance between them from median groove.

Posterior foveae large and deep, microreticulate. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.28 mm; maximum width (near midlength) 0.96 mm. Disc convex, with depression in midregion, moderately shiny, with six rows of round punctures between suture and humeri. Sides very convex, declivity origin near midlength; intervals rounded, not elevated, width equal puncture width, with fine impressed lines; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin slightly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately short and stout; ratio of hind leg length to abdominal length 1.6:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 141B)(2 examined).

Distribution. – (Figs. 139B,186). Known only from Marin County, California and Portland, Oregon.

Etymology. – Latin, *orbus* (bereft of parents). I refer to the apparently very rare nature of this species.

40. *Ochthebius mimicus* Brown
(Figs. 133E,138A,139B,186)

Ochthebius mimicus Brown, 1933:45 (holotype female in CNC; type-locality: Summerland, British Columbia, Canada). – Hatch, 1965:19.

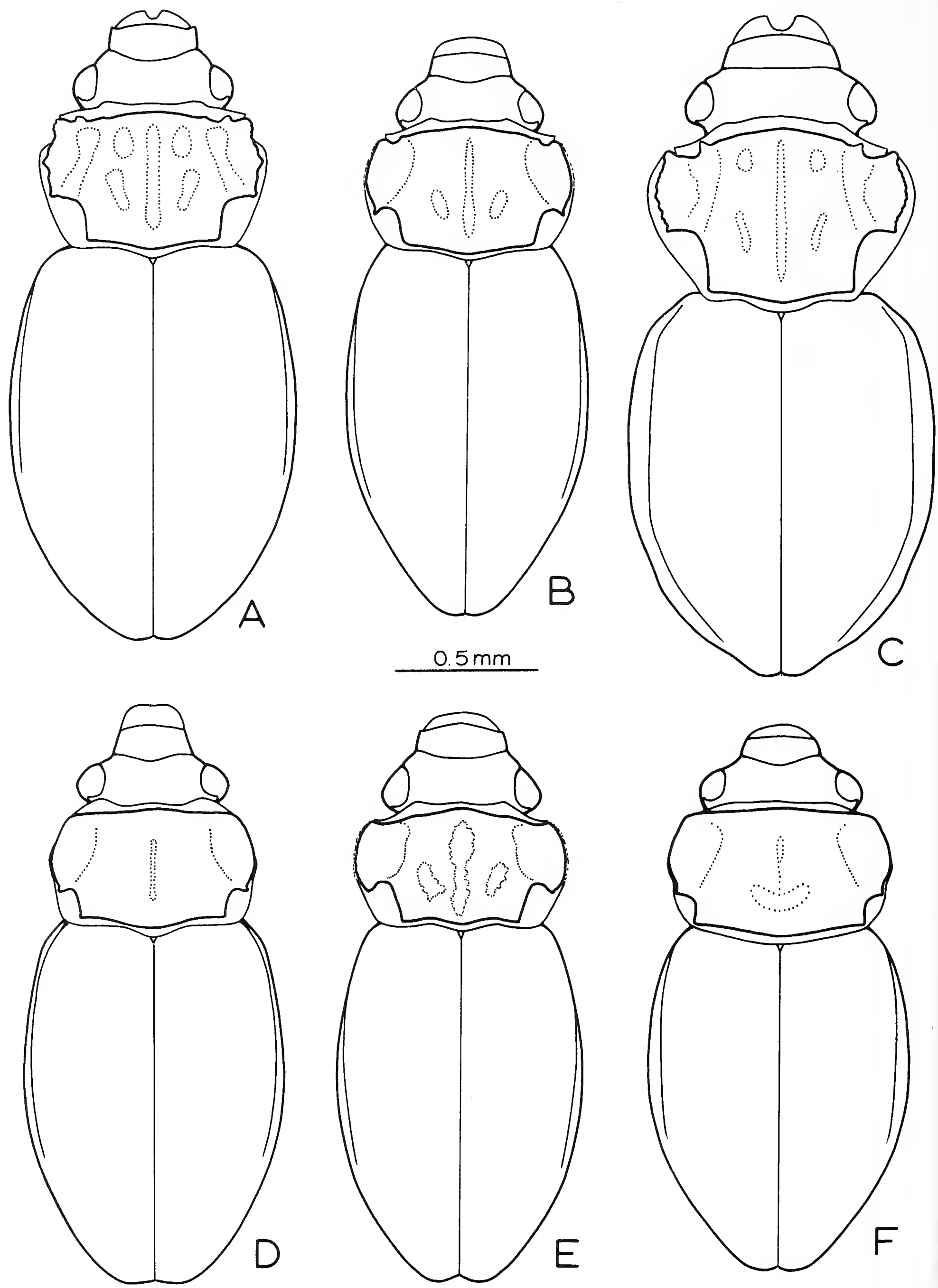
Diagnosis. – Orange-brown color, convex form and pronotal features of broad, shiny lateral depressions and produced posterior angles (Fig. 133E) serve to distinguish *O. mimicus* adults from those of its close relatives.

Description. – *Form:* Broadly ovate, convex (Fig. 133E). *Size:* Holotype 1.80 mm long, 0.84 mm wide. *Color:* Dorsum orange-brown, venter darker; legs and palpi testaceous. *Head:* Length 0.34 mm; width 0.50 mm. Frons slightly elevated, finely punctate; interocular foveae microreticulate, deep and large, width of each 0.66 distance between them; interocular tuberculi large; basomedial fovea nearly as deep and as large as interocular foveae. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; microreticulate at sides, finely pubescent. Labroclypeal suture straight. Labrum length 0.33 width, microreticulate, finely pubescent; median emargination large, edge upturned slightly. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 short, 0.33 length of 3. Mentum width equal length, shining, finely punctate; anterior margin arcuate. Submentum finely punctulate. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.42 mm; maximum width (near anterior 0.33) 0.74 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin at anterior angles, narrow along lateral depressions, wide along posterior 0.50, very narrow around posterior margin. Anterior margin of pronotum straight, with deep postocular emarginations and prominent postocular processes. Lateral depressions wide, short, shiny, with few moderately coarse punctures; pronotum markedly constricted behind lateral depressions. Lateral fossulae deeply impressed, very finely microreticulate; inner margin abrupt. Pronotal disc convex, punctures in interfoveal area moderately large, separated by puncture diameter, or less; surface between punctures smooth and shiny. Median groove narrow, moderately deep. Posterior foveae large, deep, oval, oblique, without apparent microreticulation. Anterior foveae not as apparent as posterior, limits somewhat obscured by punctation. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.12 mm; maximum width (near midlength) 0.84 mm. Disc very convex, moderately shiny, with six rows of punctures between suture and humeri. Sides convex, declivity origin near midlength. Intervals rounded, not elevated, width twice puncture diameter. Interstices between punctures equal puncture diameter; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.7:1.0. Protarsomeres without suction seta. *Genitalia:* Male (Fig. 138A)(2 examined).

Variation. – No notable, non-sexual variation was seen in the 15 specimens studied (see appendix). Females lack the protarsal suction setae of males; the labrum is very similar in the sexes.

Natural History. – No specific habitat data, other than the citation, "Little Sand Creek", is present in the locality records.

Distribution. – (Figs. 139B,186). Southern British Columbia, Washington, and northern Oregon.



Figs. 136A – F, *Ochthebius* body outlines. (A) *O. angularidus*. (B) *O. similis*. (C) *O. martini*. (D) *O. cribricollis*. (E) *O. apache*. (F) *O. brevipennis*.

41. *Ochthebius putnamensis* Blatchley
(Figs. 133F,186)

Ochthebius putnamensis Blatchley, 1910:253 (unique holotype female in PU; type-locality: Putnam County, Indiana, U.S.A.).

Diagnosis. – Small size, very convex form and absence of postocular emarginations serve to distinguish adults of this species from others of the *discretus* Subgroup.

Description. – *Form:* Broadly ovate, very convex (Fig. 133F). *Size:* Holotye 1.44 mm long, 0.80 mm wide. *Color:* Dark brown, legs and palpi slightly lighter. *Head:* Length 0.34 mm; width 0.48 mm. Frons slightly elevated, finely punctate; interocular foveae microreticulate, deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial fovea ill-defined. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, finely punctate, finely pubescent. Labroclypeal suture straight. Labrum large, length nearly 0.50 width, microreticulate, finely pubescent; median emargination well developed, edge not upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 short, 0.33 length of 3. Mentum width equal length, shining, finely punctate, finely pubescent, anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near midlength) 0.70 mm. Anterior hyaline border narrow in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin at anterior angles, very narrow along lateral depressions, wide along posterior sides, very narrow around posterior margin. Anterior margin of pronotum slightly arcuate in midline, with short, rather broad postocular processes, without postocular emarginations. Lateral depressions flat, broad, posterior angles acute processes. Pronotum markedly constricted behind lateral depressions. Lateral fossulae deeply impressed, finely microreticulate, inner margin abrupt. Pronotal disc very convex, punctures coarse and dense along median groove, decreased in density laterally; finely, very sparsely pubescent; surface between punctures smooth and shiny. Median groove microreticulate, moderately deep, widest at posterior, anterior with indistinctly defined margins, punctures dense. Posterior foveae deep, large, oblong, finely microreticulate. Anterior foveae deep, moderately large. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities, coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 0.98 mm; maximum width (near midlength) 0.80 mm. Disc very convex, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity beginning near posterior 0.33. Intervals rounded, very slightly elevated, width 0.50 puncture diameter, with fine impressed lines. Interstices between punctures 0.25 puncture diameter. Each puncture with seta. Explanate margin slightly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately short and stout; ratio of hind leg length to abdominal length 1.5:1.0. Protarsomeres without suction setae. *Genitalia:* Male unknown.

Natural History. – Blatchley (1910) reports that the holotype was "sifted from debris at side of hillside spring".

Distribution. – (Fig. 186) Known only from the type-locality, Putnam County, Indiana.

The *similis* Subgroup

Adults of this subgroup are characterized by pronotal sculpture, which lacks anterior foveae, this region being flat and moderately to finely punctate.

The one included species, *O. similis* , is known from Guatemala, Mexico and Arizona.

42. *Ochthebius similis* Sharp
(Figs. 136B,138B,142A,187A)

Ochthebius similis Sharp, 1882:92 (holotype female in BMNH; type-locality: Guatemala City, Guatemala).
Ochthebius wickhami Fall, 1901:213 (holotype female in MCZ; type-locality: Winslow, Arizona, U.S.A.; new synonomy).

Fall's type-specimen does not differ significantly from Sharp's type-specimen. Refer to the section on variation for further comments.

Diagnosis. – Lack of anterior pronotal foveae and distinctive body form (Fig. 136B) serve as diagnostic characteristics for *O.similis* adults.

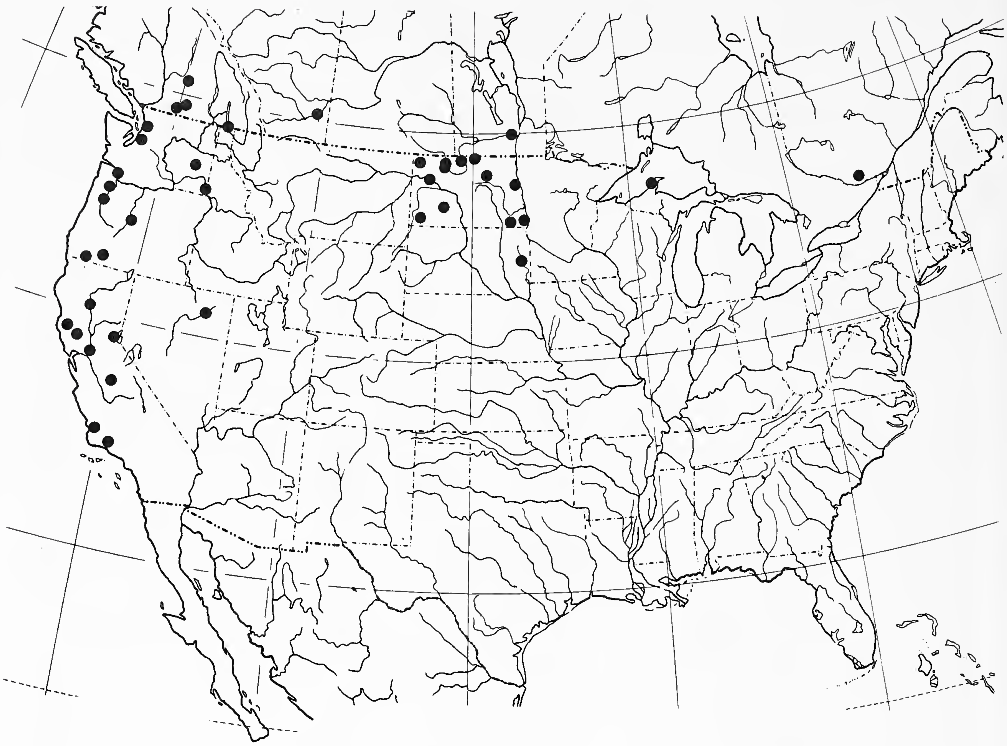
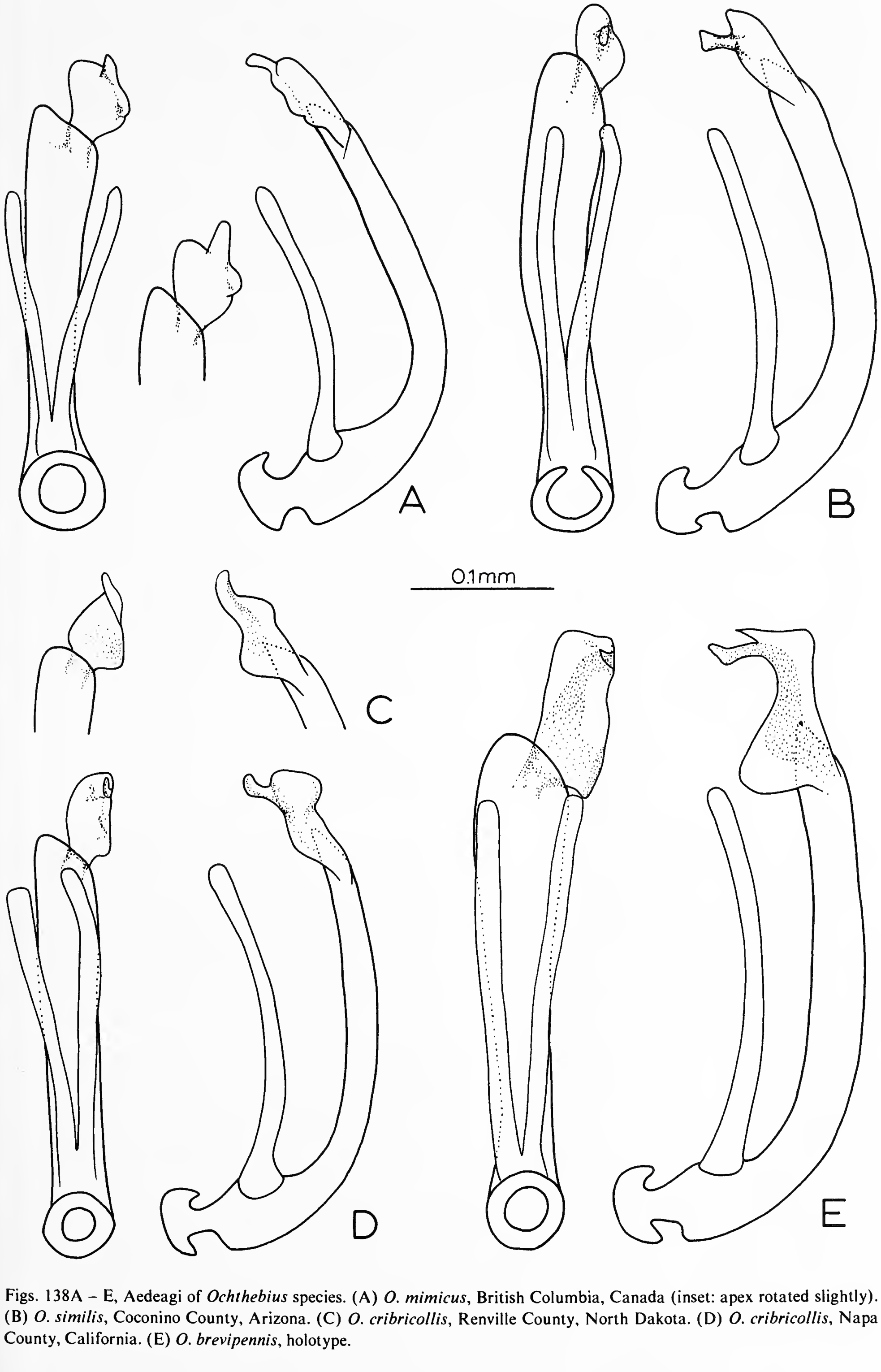


Fig. 137. Geographical distribution of *Ochthebius cribricollis*.

Description. – Form: Ovate, slightly depressed (Fig. 136B). *Size:* Holotype 2.05 mm long, 0.93 mm wide. *Color:* Brown tending toward testaceous, head darker. *Head:* Length 0.38 mm; width 0.52 mm. Frons finely, sparsely punctate; interocular foveae deep and large, width of each equal to distance between them; interocular tuberculi large, basomedial fovea nearly as deep and as large as interocular foveae. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with microreticulation and fine hairs. Labroclypeal suture straight. Labrum length 0.33 width; surface microreticulate, finely pubescent; median emargination weakly developed. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, finely, sparsely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.50 mm; maximum width (near anterior 0.33) 0.74 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin at anterior angles, extended very narrowly along lateral depressions, wide in region of excavation, very narrow around posterior margin. Anterior margin of pronotum straight, with small excavation in front of each lateral depression; anterior angles obtuse. Lateral depressions slightly inflated, broad, finely sparsely punctate; margins arcuate, posterior extreme excavate, with small tooth lateral to excavation; pronotum constricted behind lateral depressions. Lateral fossulae deeply impressed, slightly microreticulate; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately flat, finely, sparsely punctate, punctures separated by one-three times puncture diameter; with fine, very sparse hairs; surface between punctures smooth and shiny. Median groove narrow, moderately deep channel, very slightly constricted in middle. Anterior foveae absent. Posterior foveae large, deeply impressed. Posterolateral angles with shallow impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.32 mm; maximum width (near midlength) 0.92 mm. Disc slightly convex, with a shallow depression in midregion, moderately shiny, with six rows of round punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; intervals rounded, width equal puncture width, surface smooth; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin slightly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with



Figs. 138A – E, Aedeagi of *Ochthebius* species. (A) *O. mimicus*, British Columbia, Canada (inset: apex rotated slightly). (B) *O. similis*, Coconino County, Arizona. (C) *O. cribricollis*, Renville County, North Dakota. (D) *O. cribricollis*, Napa County, California. (E) *O. brevipennis*, holotype.

very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 2.0:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Fig. 138B)(6 examined).

Variation. – The holotype and the two Mexican specimens, one male each from the states of Hidalgo and Veracruz (see appendix), are darker and have the pronotal punctation and posterior foveae slightly more impressed than specimens from Arizona. Aedeagi from all areas, however, are virtually identical. Males are easily distinguished from females by their unusually large pads of protarsal suction setae.

Natural History. – Other than the locality record, "Salt Creek" (Coconino County, Arizona), no indications of habitat are given. Judging from the Arizona records, this species appears to be restricted to streams of arid regions. The holotype from Guatemala City (5,000 ft.) and the Vera Cruz specimen, however, suggest a less restricted ecological tolerance. The single male from Pachuca, Hidalgo, Mexico was in a series with 25 specimens of *G. fossatus.*

Distribution. – (Figs. 142A,187A). Known from Guatemala City (holotype), central Mexico (two males), and central Arizona (nine specimens, including Fall's type-specimen) (see appendix).

The *cribricollis* Subgroup

Adults of this subgroup, which have historically been placed in the subgenus *Homalochthebius*, are characterized by absence of both anterior and posterior pronotal foveae.

One of the two presently included species, *O. cribricollis* , ranges across North America in a rather narrow band near the Canada–U.S.A. border, and southward in the Pacific Coast states to southern California. The other species, *O. brevipennis* , is found from southern British Columbia southward to northern California.

43. *Ochthebius cribricollis* LeConte
(Figs. 136D,137,138C,D,187A)

Ochthebius cribricollis LeConte, 1850:217 (lectotype male in MCZ, here designated; type-locality: Eagle Harbor, Michigan, U.S.A.). – LeConte, 1852:361. – LeConte, 1878:378. – Horn, 1890:22. – Leech and Chandler, 1956:333. – Hatch, 1965:19.

Diagnosis. – Absence of pronotal foveae easily distinguishes *O. cribricollis* adults from all other Western Hemisphere *Ochthebius*, except *O. brevipennis* . Adults of much rarer *O. brevipennis* differ in the possession of a shallow, transverse depression at the base of the median groove, shorter elytra, and aedeagal form (Figs. 136D,F,138C-E).

Description. – *Form:* Ovate, somewhat depressed (Fig. 136D). *Size:* Lectotype 2.00 mm long, 0.92 mm wide. *Color:* Lateral depressions of pronotum, legs, palpi and antennae testaceous, remainder dark brown. *Head:* Length 0.40 mm; width 0.54 mm. Frons moderately coarsely, moderately densely punctate, microreticulate, weakly pubescent; interocular foveae moderately deep and moderately large, width of each nearly 0.50 distance between them; interocular tuberculi large, basomedial fovea nearly as deep and as large as interocular foveae. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; finely, sparsely punctate, markedly microreticulate, finely pubescent. Labroclypeal suture straight. Labrum length slightly greater than 0.33 width; microreticulate, sparsely pubescent; extremely slightly emarginate, entire anterior border extremely slightly upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, finely sparsely punctate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.44 mm; maximum width (near anterior 0.33) 0.74 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near anterior angles, extended extremely narrowly along lateral depressions, moderately wide at excavations, very narrow around posterior margin. Anterior margin of pronotum straight, without crenulations in front of lateral fossulae and without excavation in front of each lateral depression; anterior angles obtuse. Lateral depressions flat, broad, smooth and shiny, sparsely,

moderately finely punctate, pubescence not apparent; margins moderately arcuate, moderately excavate at posterior, small tooth lateral to excavations; pronotum slightly constricted behind lateral depressions. Lateral fossulae shallowly impressed, with weakly developed microreticulation; inner margin abrupt, posterior extreme ended before lateral hyaline border. Pronotal disc slightly convex, shiny, moderately finely, moderately densely punctate, punctures separated by 0.5-1.0 times puncture diameter, non-pubescent and non-microreticulate. Median groove shallow, extremely narrow. Anterior foveae absent. Posterior foveae absent, this region very slightly depressed. Posterolateral angles without impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.28 mm; maximum width (near midlength) 0.92 mm. Disc flat, moderately dull, with six rows of punctures between suture and humeri. Sides convex, declivity beginning near posterior 0.33; punctures round, intervals flat, width twice puncture width, with dense fine impressed lines; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin weakly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 2.0:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Figs. 138C,D)(17 examined).

Variation. – The aedeagal apex varies slightly; I have illustrated the maximum variation noted, using a specimen from Napa County, California (Fig. 138D) and a specimen from Sherwood, Renville County, North Dakota (Fig. 138C). I have examined 151 specimens (see appendix).

Natural History. – It appears that this species has its greatest reproductive potential in pond environments. This assertion is suggested by prevalence of such locality descriptors as "sandy pool near Osoyoos Lake", "pond meadow", "small pond", "flood water", "mud bank along lake" and other such indications of lentic habitats.

Distribution. – (Figs. 137,187A). Generally distributed in the Pacific Coast region of North America from Santa Barbara, California to southern British Columbia, and trans-continental as a rather narrow band near the U.S.A.–Canadian border. Easternmost known locality is Wakefield, Quebec, Canada.

Remarks. – The lectotype aedeagus is of the form I have illustrated (Fig. 138C) using a specimen from Sherwood, Renville County, North Dakota.

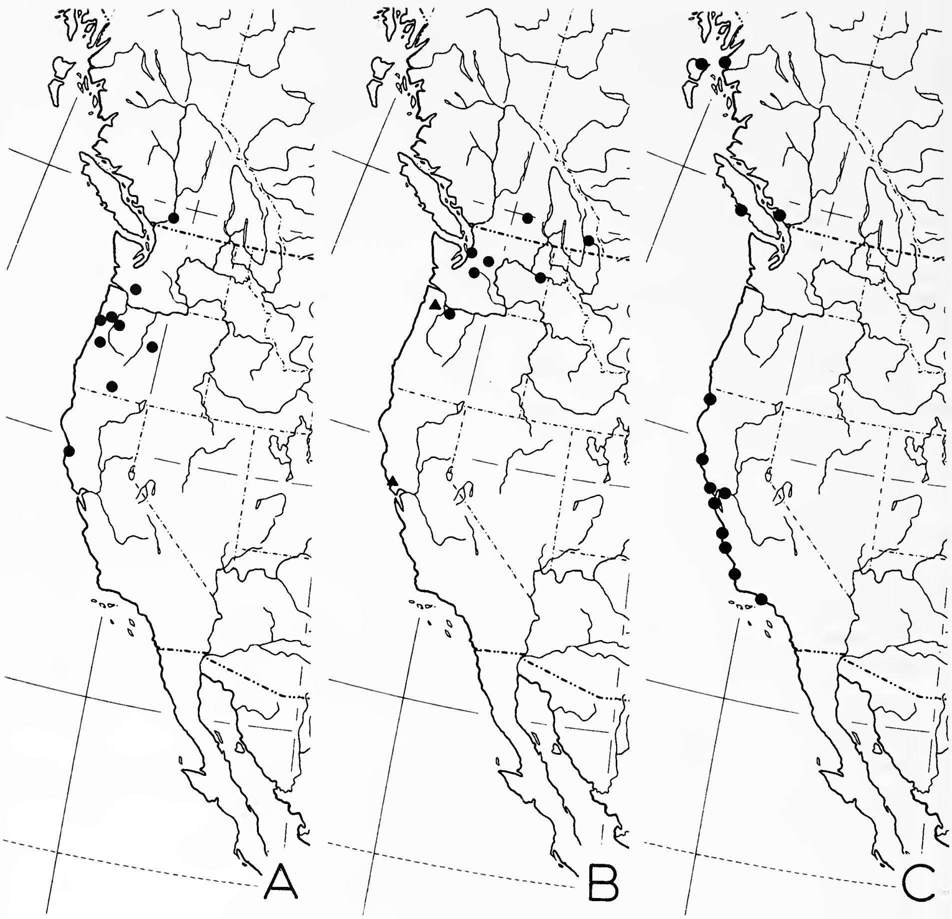
44. *Ochthebius brevipennis* new species
(Figs. 136F,138E,139A,187A)

Type-locality. – Under rocks by lake, Tierra del Mar, Tillamook County, Oregon, U.S.A.

Type-specimens. – The holotype male and allotype with identical locality data are deposited in USNM. They were collected in 1938 (collector unknown). Data about paratypes (31) are presented in the appendix.

Diagnosis. – Lack of anterior and posterior pronotal foveae distinguish specimens of *O. brevipennis* from all Western Hemisphere *Ochthebius*, except *O. cribricollis* . *O. brevipennis* specimens differ from the latter by a shallow, transverse depression at the base of the median groove, shorter elytra, and form of male genitalia (Figs. 136D,F,138C-E).

Description. – *Form:* Ovate, moderately convex with head slightly deflexed (Fig. 136F). *Size:* Holotype 1.80 mm long, 0.88 mm wide. *Color:* Dorsum black except testaceous elytral apices; venter dark brown; legs, palpi and antennae testaceous. *Head:* Length 0.38 mm; width 0.52 mm. Frons moderately densely punctate laterally, markedly microreticulate medially, moderately pubescent; interocular foveae shallow, moderately large, width of each nearly 0.66 distance between them; interocular tuberculi large, basomedial foveae nearly as deep and as large as interocular foveae. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; markedly, finely microreticulate, moderately pubescent. Labroclypeal suture straight. Labrum length 0.33 width; microreticulate, densely pubescent; median emargination absent, entire anterior margin very slightly upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, dull, densely, moderately finely punctate, anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.55 mm; maximum width (near anterior 0.33) 0.74 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near



Figs. 139A – C, Geographical distributions. (A) *Ochthebius brevipennis*. (B) *O. mimicus* ● and *O. orbus* ▲. (C) *Neochthebius vandykei*.

anterior angles, extended extremely narrowly along lateral depressions, moderately wide at excavations, very narrow around posterior margin. Anterior margin of pronotum straight, without crenulations in front of lateral fossulae and without excavation in front of each lateral depression; anterior angles obtuse. Lateral depressions flat, deflexed, moderately finely, densely punctate, moderately pubescent; margins moderately arcuate, moderately excavate at posterior, small tooth lateral to excavation; pronotum slightly constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, shallowly microreticulate; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, densely moderately coarsely punctate, moderately pubescent; surface between punctures smooth and shiny. Median groove shallow, extremely narrow. Anterior foveae absent, this region densely punctate and slightly depressed. Posterior foveae broadly confluent in form of transverse punctate and microreticulate depression. Posterolateral angles with shallow impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.16 mm; maximum width (near midlength) 0.88 mm. Disc convex, shiny, with six rows of irregularly shaped punctures between suture and humeri. Sides convex, declivity origin near midlength; intervals flat, width equal puncture width, with fine impressed lines; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin moderately

developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine short hairs. *Legs:* All legs moderately long and stout; ratio of hind leg length to abdominal length 1.8:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 138E)(6 examined).

Natural History. – The locality data indicate that this species, like its close phylogenetic relative, *O. cribricollis* , is primarily a pond species. Habitat descriptors include: "marshy pond", "small pond", "flood water", "mud bank along lake", and "under rocks by lake".

Distribution. – (Figs. 139A,187A). From Mendocino County, California northward to southern British Columbia. Most widespread in Oregon.

Etymology. – Latin, *brevis* (short) plus *pennis* (wing). I refer to the elytra, which are relatively short when compared to those of *O. cribricollis* , the most closely related species.

The *reticulocostus* Subgroup

This subgroup is characterized by the densely, coarsely punctate region generally occupied by the anterior foveae. The latter are either absent or greatly obscured by the punctation.

One of the five included species, *O. apache* , is known from Mexico and the adjacent areas of southern Arizona, New Mexico and Texas. The four other species are known only from Mexico (Fig. 188).

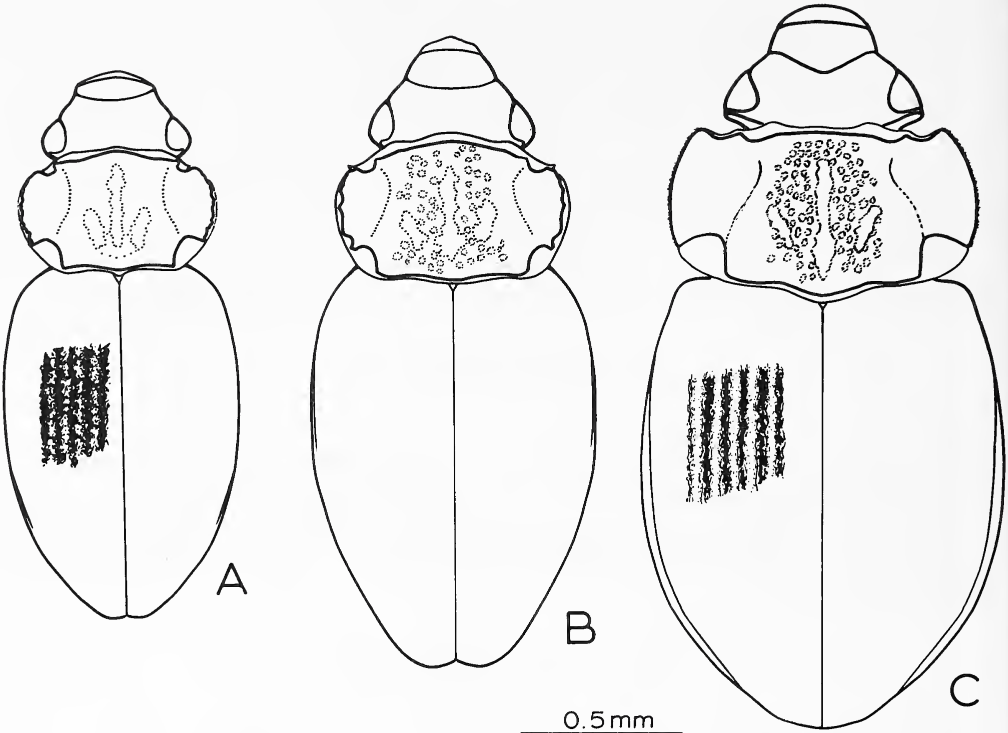
45. *Ochthebius apache* new species
(Figs. 136E,141D,142A,187B)

Type-locality. – Carr Canyon, 7100 feet, Huachuca Mountains, Cochise County, Arizona, U.S.A.

Type-specimens. – The holotype male and allotype with identical locality data are in USNM. They were collected by Alan R. Gillogly, May 3, 1972. Data about paratypes (43) are presented in the appendix.

Diagnosis. – Lack of pronotal postocular emarginations is sufficient to distinguish *O. apache* adults from those of other species of *O.* (*Asiobates*) which also lack anterior pronotal foveae (Fig. 136E).

Description. – *Form:* Ovate, moderately convex (Fig. 136E). *Size:* Holotype 2.00 mm long, 0.92 mm wide. *Color:* Dorsum and venter black; legs and palpi dark brown. *Head:* Length 0.38 mm; width 0.54 mm. Frons with dense punctures, some confluent, microreticulation well developed, with very fine hairs; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial fovea less deep and smaller than interocular foveae. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; with well developed microreticulation and fine hairs. Labroclypeal suture straight. Labrum length 0.33 width; surface with microreticulation and dense fine hairs; anterior margin deeply emarginate, medially. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 slightly less than 0.50 length of 3. Mentum width equal length, shining, with microreticulation and small punctures; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.48 mm; maximum width (near anterior 0.33) 0.76 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin near posterior extreme of lateral depression, extended slightly arcuate to posterior angles, very narrow around posterior margin. Anterior margin of pronotum slightly sinuate, with very slightly produced sinuation in midline and in front of each lateral fossula; anterior angles obtuse. Lateral depressions flat, broad, with large, rather widely spaced punctures; very sparsely pubescent; margins moderately arcuate, posterior extreme excavated; pronotum markedly constricted behind lateral depressions. Lateral fossulae deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, with large, deep, dense, very regularly spaced punctures over entire surface, punctures separated by puncture diameter or less, but not confluent; with fine sparse hairs; surface between punctures smooth and shiny. Median groove deeply impressed, enlarged anteriorly and posteriorly as broad ovals with well developed microreticulation; anterior portion twice as large as posterior; median 0.33 shallow, narrow furrow joined to both depressions. Anterior foveae absent, this area with very discrete



Figs. 140A – C, *Ochthebius* body outlines. (A) *O. reticulocostus*. (B) *O. browni*. (C) *O. mexicanus*.

punctures. Posterior foveae large and very deep with punctures and microreticulation. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.28 mm; maximum width (near midlength) 0.92 mm. Disc flat, with broad, shallow depression in middle, moderately shiny, with six rows of punctures between suture and humeri; first three rows from suture slightly disordered in anterior 0.33. Sides convex, declivity origin near posterior 0.33; punctures round; intervals rounded, slightly elevated, width equal puncture width, with some surface irregularities; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin slightly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.7:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 141D)(20 examined).

Variation. – No significant differences were detected in the specimens studied.

Natural History. – Apparently restricted to streams of arid and semi-arid habitats. The one specimen (male) from 29 mi.SW of Zacatecas, Mexico, was taken from the sand and gravel at the margin of a desert stream; *O. sculptoides* was also collected at this locality. A series of hydraenids collected by Frank N. Young at Rustler's Park, Cochise County, Arizona, contained adults of this species, and of *Hydraena bituberculata, H. arizonica*, and *H. circulata*.

Distribution. – (Figs. 142A,187B). Presently known to inhabit the mountains of southeastern Arizona, the Rio Grande River drainage in New Mexico and Texas, and the state of Zacatecas, Mexico.

Etymology. – A noun in apposition, *apache*, referring to the Apache Amerindians of the southwestern United States, and to the hatchet, or "tomahawk" shape of the pronotal lateral depressions.

46. *Ochthebius browni* new species
(Figs. 140B,143C,187B)

Type-locality. – Vicinity of San Antonio, between Toluca and Temascaltepec, Mexico, Mexico.

Type-specimens. – The holotype male and allotype are in USNM; one paratype female in PDP; all with identical locality data. These three specimens were collected by Harley P. Brown, October 11, 1966.

Diagnosis. – This species is similar to *O. apicalis* in that adults of both have the pronotum densely punctate in the region normally occupied by the anterior foveae. *O. browni* differs in being larger, less robust and lacking the distinctive fusiform shape of *O. apicalis*. Male genitalia of the two species differ remarkably (Figs. 143A-C).

Description. – *Form:* Ovate, moderately convex (Fig. 140B). *Size:* Holotype 1.84 mm long, 0.92 mm wide. *Color:* Dorsum and venter dark red-brown; legs and palpi orange-brown. *Head:* Length 0.36 mm; width 0.52 mm. Frons prominently microreticulate over entire surface; punctures dense, but somewhat obscured by microreticulation; very finely pubescent; interocular foveae deep and large, width of each equal to distance between them; interocular tuberculi large; basomedial foveae nearly as deep as interocular foveae, smaller. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; markedly microreticulate. Labroclypeal suture straight. Labrum length 0.33 width; microreticulate, finely pubescent; median emargination well developed, edge upturned. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 slightly less than 0.50 length of penultimate. Mentum width equal length, shining, with small punctures; anterior margin straight. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.46 mm; maximum width (near anterior 0.20) 0.70 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin at anterior angles, extended extremely narrowly along lateral depressions, broad in region of posterior excavation, very narrow around posterior margin. Anterior margin of pronotum straight, without crenulations in front of lateral fossulae, with excavation in front of each lateral depression; anterior angles obtuse. Lateral depressions very slightly inflated, broad, with large punctures and internal microreticulation; margins moderately arcuate; posterior extremes excavate with very small tooth; pronotum moderately constricted behind lateral depressions. Lateral fossulae moderately deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, punctures in interfoveal area moderately large, dense, irregularly sized, separated by thin walls in anterior, some in posterior separated by puncture diameter; with fine, sparse hairs; surface between punctures smooth and shiny. Median groove deeply impressed, narrow channel with well developed microreticulation; anterior and posterior 0.33 very slightly wider than median 0.33. Anterior foveae absent, this region with dense deep punctures. Posterior foveae large, deep, and microreticulate. Posterolateral angles with distinct impressions. Prosternum with median carina ending at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.28 mm; maximum width (near midlength) 0.92 mm. Disc with broad depression in midregion, moderately shiny, with six rows of punctures between suture and humeri. Sides convex, declivity beginning near posterior 0.33; punctures round; intervals rounded, slightly elevated, width equal puncture width, with surface irregularities; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin slightly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* All legs moderately long and slender; ratio of hind leg length to abdominal length 1.8:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 143C)(1 examined).

Variation. – Too few specimens are available to assess variation other than sexual: females lack both protarsal suction setae and upturned edge of the labrum.

Distribution. – (Fig. 187B). Known only from the type-locality in the state of Mexico, Mexico.

Etymology. – I acknowledge with pleasure the contributions made to this study by the collecting efforts of Harley P. Brown, by naming this species after him.

47. *Ochthebius mexicanus* new species
(Figs. 140C,141C,142B,187B)

Type-locality. – Temescaltepec, Mexico, Mexico.

Type-specimen. – The holotype male (unique) is deposited in BMNH. This specimen was collected by H.E. Hinton and R.L. Usinger (no date).

Diagnosis. – The combination of large size, 2.28 x 1.04 mm, broad form (Fig. 140C), and costate elytral intervals serve as diagnostic characteristics for this distinctive species. Pronotal punctures are deeply impressed and moderately coarse, interstices elevated and microreticulate but not markedly so. Its body form and sculpture presents a much different facies than that of *O. browni*, the closest relative.

Description. – *Form:* Ovate, elytra rather markedly convex (Fig. 140C). *Size:* Holotype 2.28 mm long, 1.04 mm wide. *Color:* Brown. *Head:* Length 0.44 mm; width 0.60 mm. Frons deeply, densely, moderately coarsely punctate; interstices microreticulate; interocular foveae deep and large, width of each equal to distance between them; interocular tuberculi large, shining; basomedial fovea nearly as large and as deep as interocular foveae. Frontoclypeal suture angulate, deeply impressed. Clypeus length 0.50 width, sculptured as frons, pubescent laterally. Labrum length slightly less than 0.50 width, microreticulate, anterior margin rounded except for small median emargination. Maxillary palpus with palpomere 3 relatively narrow; palpomere 4 0.50 length of 3. Mentum width equal length, coarsely, deeply punctate; anterior margin arcuate to rear. Submentum microreticulate. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.56 mm; maximum width (near midlength) 0.98 mm. Anterior hyaline border moderately wide in front of disc, wider in front of lateral fossulae, very narrow in postocular emarginations. Lateral hyaline border origin near midlength of lateral depressions, very narrow along posterior part of lateral depressions, wide at excavation, very narrow around posterior margin. Anterior margin of pronotum straight in midregion, turned upward slightly in front of lateral fossulae, postocular emarginations well developed. Lateral depressions broad, slightly convex in midregion, coarsely, deeply punctate, interstices shallowly microreticulate; margins moderately arcuate, excavate at posterior; pronotum constricted behind lateral depressions. Lateral fossulae deeply impressed, especially at anterior. Pronotal disc convex, densely, deeply, moderately coarsely punctate, interstices shallowly microreticulate ridges. Median groove deeply impressed in anterior and posterior, obsolete in midregion. Anterior foveae absent. Posterior foveae large, deeply impressed. Posterolateral angles with broad depressions. Prosternum with low median ridge; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.36 mm; maximum width (near midlength) 1.04 mm. Disc convex, dull, shallowly microreticulate, with seven rows of ill-defined punctures between suture and humeri. Declivity origin near posterior 0.33. Intervals costate, width slightly greater than puncture width. Explanate margin moderately developed; right elytron crenulate in anterior 0.25 of margin, left elytron missing from specimen. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* All legs moderately long and slender. Protarsomeres 1-3 with apparently unexpanded setae. *Genitalia:* Aedeagus as illustrated (Fig. 141C)(1 examined).

Distribution. – (Figs. 142B,187B). Presently known only from the type-locality, Temescaltepec, Mexico, Mexico.

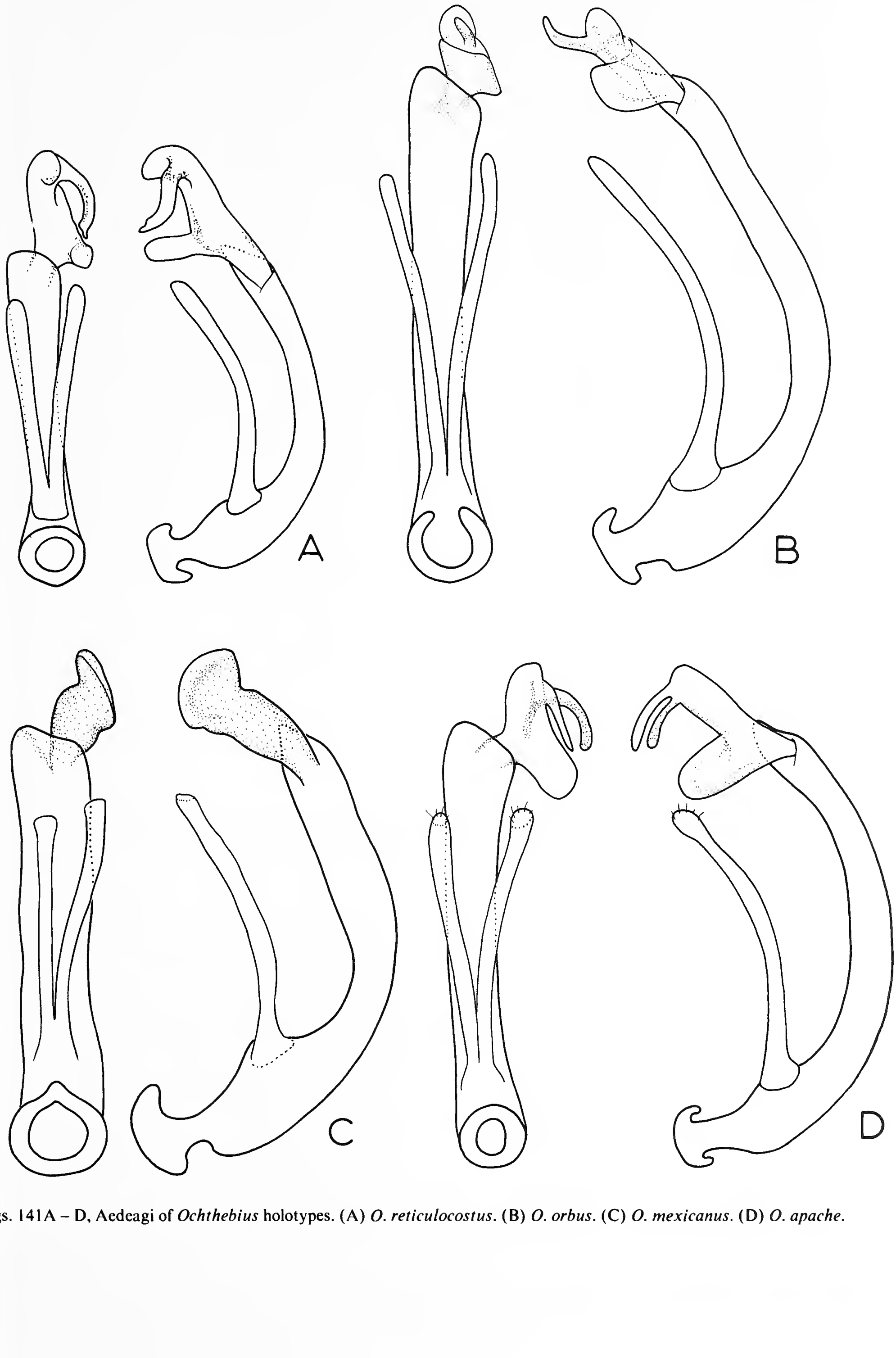
Etymology. – Adjective, *mexicanus*, in reference to location of collection of the holotype.

48. *Ochthebius reticulocostus* new species
(Figs. 140A,141A,142B,187B)

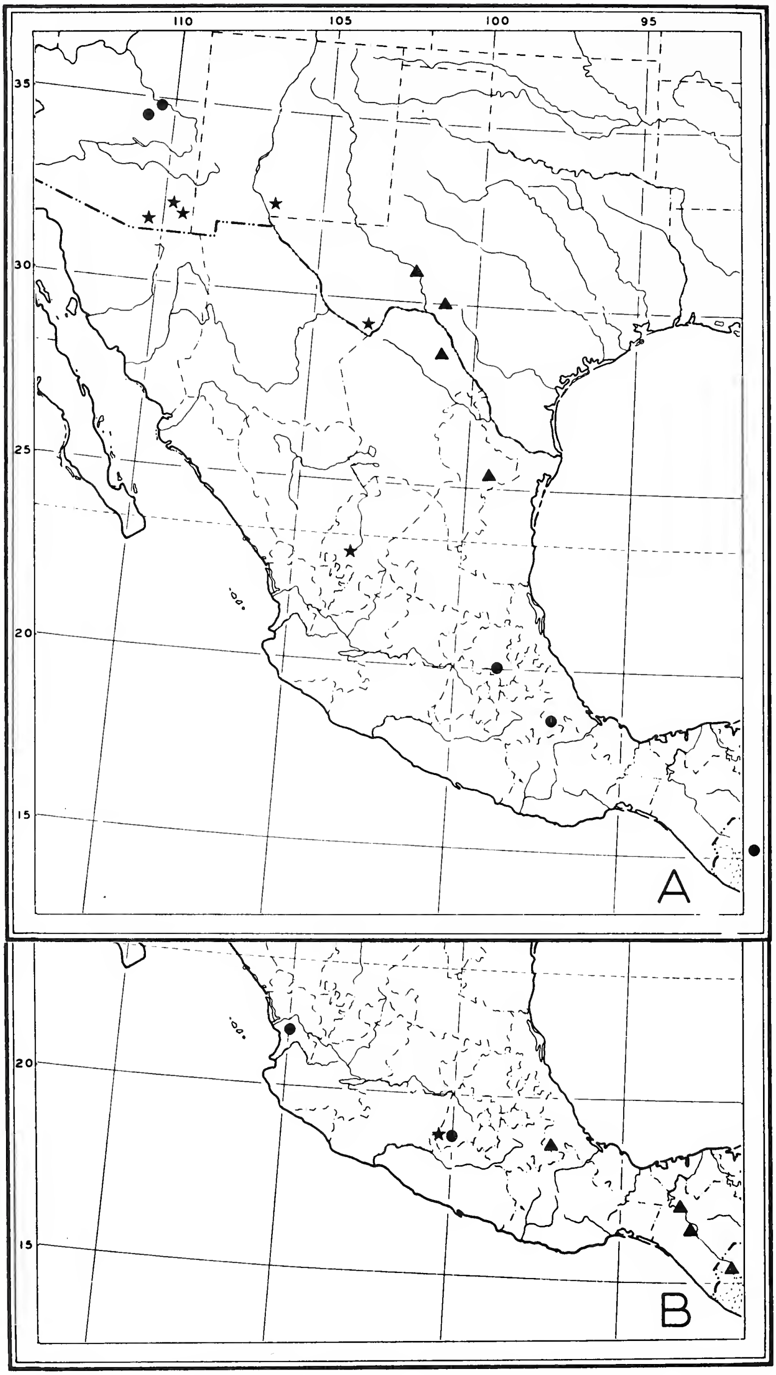
Type-locality. – Vicinity of San Antonio, between Toluca and Temascaltepec, Mexico, Mexico.

Type-specimens. – The holotype male is deposited in USNM. It was collected by H.P. Brown, October 11, 1966. The allotype, collected by B. Malkin, September 22, 1953, is from Ixtlan del Rio, Nayarit, Mexico. It is also deposited in USNM.

Diagnosis. – Among those species of *O.* (*Asiobates*) whose adults lack discrete anterior pronotal foveae, *O. reticulocostus* is distinctive by virtue of its markedly microreticulate dorsum and costate elytral intervals. Smaller size, narrower form (Fig. 140A) and more markedly developed microreticulation readily distinguish *O. reticulocostus* adults from those of



Figs. 141A – D, Aedeagi of *Ochthebius* holotypes. (A) *O. reticulocostus*. (B) *O. orbus*. (C) *O. mexicanus*. (D) *O. apache*.



Figs. 142A – B, Geographical distributions of *Ochthebius* species. (A) *O. similis* ●, *O. apache* ★ and *O. angularidus* ▲. (B) *O. reticulocostus* ●, *O. mexicanus* ★ and *O. apicalis* ▲.

O. mexicanus , the only other species of *Asiobates* characterized by costate, microreticulate elytral intervals.

Description. – *Form:* Slightly truncate, moderately convex (Fig. 140A). *Size:* Holotype 1.64 mm long, 0.76 mm wide. *Color:* Brown. *Head:* length 0.32 mm; width 0.48 mm. Frons densely, moderately coarsely punctate, markedly microreticulate; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large; basomedial foveae nearly as deep and as large as interocular foveae. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width, sculpture as frons. Labroclypeal suture straight. Labrum length 0.33 width, microreticulate, moderately emarginate. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, densely, moderately coarsely punctate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.40 mm; maximum width (near anterior 0.33) 0.64 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin at anterior angles, extended extremely narrowly along lateral depressions, wide at excavations, very narrow around posterior margin. Anterior margin of pronotum very slightly produced in midline, with deep excavations in front of each lateral depression; anterior angles obtuse. Lateral depressions flat, broad, densely, moderately coarsely punctate, markedly microreticulate; margins moderately arcuate, excavated at posterior, tooth lateral to each excavation; pronotum constricted behind lateral depressions. Lateral fossulae very deeply impressed, with well developed microreticulation; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, densely, moderately coarsely punctate, subrugulose, markedly microreticulate, narrow ridges between punctures. Median groove narrow, moderately deeply impressed, present in middle 0.50 of pronotum only, confluent in posterior with confluent posterior foveae. Anterior foveae not apparent, this region rugulose with dense punctation. Posterior foveae deep, posterior extremes confluent in form of U-shaped depression which is densely punctate and strongly microreticulate. Posterolateral angles with distinct impressions. Prosternum with median carina ending at coxal cavities; coxae contiguous. Metasternum with moderately large median glabrous area. *Elytra:* Length 1.08 mm; maximum width (near midlength) 0.76 mm. Disc convex, dull, markedly microreticulate, with six rows of punctures between suture and humeri. Sides convex, declivity origin near posterior 0.33; punctures round, intervals costate, strongly microreticulate, width equal puncture width, with fine impressed lines; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin weakly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.8:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Fig. 141A)(1 examined).

Distribution. – (Figs. 142B,187B) Presently known only from the states of Nayarit and Mexico, Mexico.

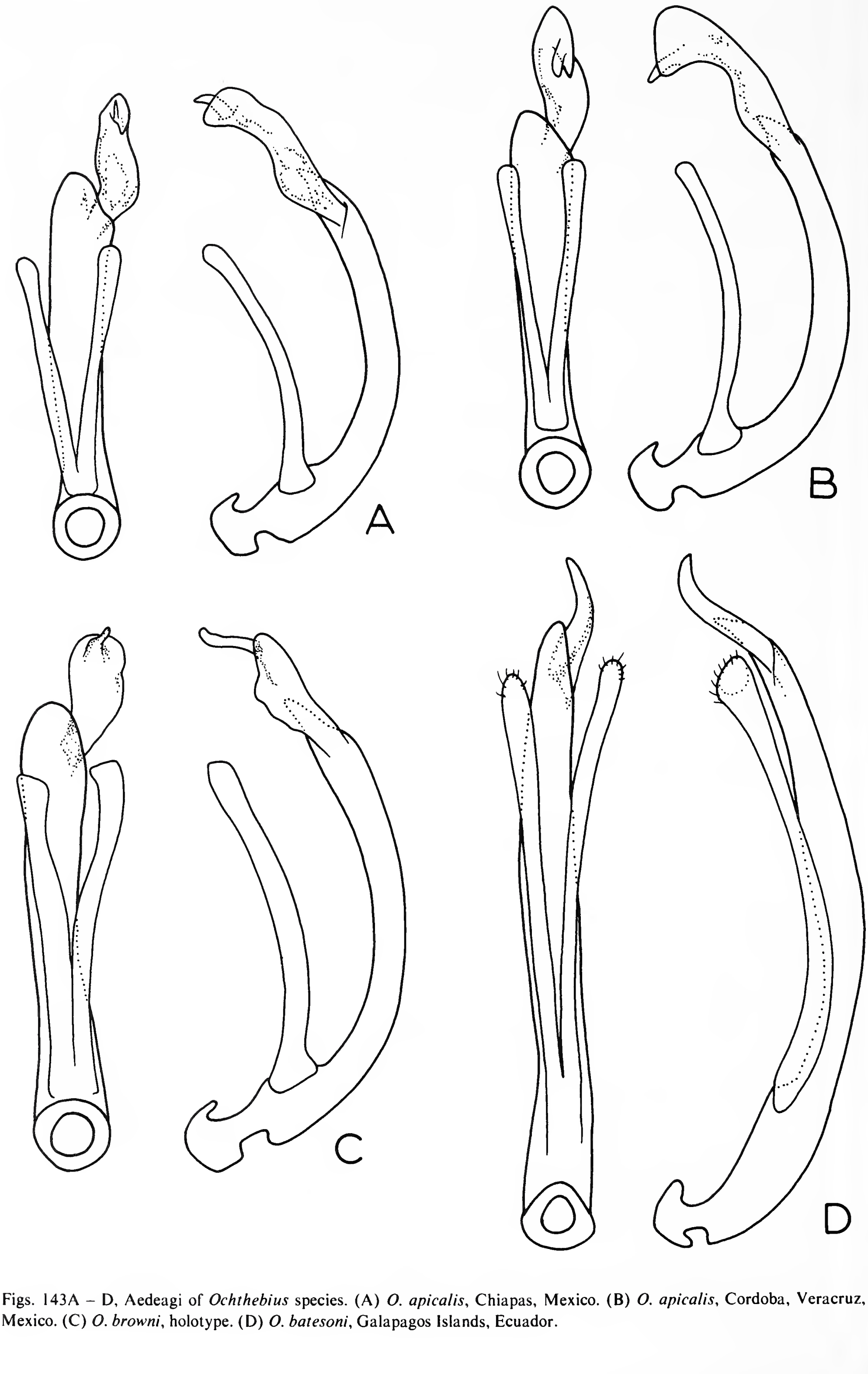
Etymology. – Latin, *reticulatus* (net-like) plus *costus* (ridge). Named in reference to the microreticulate dorsal surface and costate elytra.

49. *Ochthebius apicalis* Sharp
(Figs. 132A,142B,143A,B,187B)

Ochthebius apicalis Sharp, 1882:91 (lectotype male in BMNH, here designated; type-locality: Guatemala City, Guatemala).

Diagnosis. – Distinctive by small size, lack of discrete anterior pronotal foveae, and especially, fusiform body shape of adults.

Description. – *Form:* Fusiform, very convex (Fig. 132A). *Size:* Lectotype 1.60 mm long, 0.84 mm wide. *Color:* Dorsum and venter red-brown; legs, palpi and antennae orange-brown. *Head:* Length 0.32 mm; width 0.44 mm. Frons densely punctate, microreticulate; interocular foveae deep and large, width of each 0.66 distance separating them; interocular tuberculi large; basomedial fovea smaller, shallower than interocular foveae. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; microreticulate, densely punctate, sparsely pubescent. Labroclypeal suture straight. Labrum length 0.33 width, finely sparsely punctate, sparsely pubescent; anterior margin broadly emarginate, edge upturned slightly along entire margin. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.50 length of 3. Mentum width equal length, shining, finely sparsely punctate, anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.42 mm; maximum width (near anterior 0.33) 0.64 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin at anterior angles, extended very narrowly along lateral depressions, wide at excavations, very narrow around posterior margin. Anterior margin of pronotum slightly produced in middle, deep excavations in front of each lateral depression; anterior angles acute. Lateral depressions flat, broad, densely punctate, microreticulate; margins moderately arcuate, posterior excavate, small tooth lateral to excavation; pronotum quite constricted behind lateral depressions. Lateral fossulae deeply impressed,



Figs. 143A – D, Aedeagi of *Ochthebius* species. (A) *O. apicalis*, Chiapas, Mexico. (B) *O. apicalis*, Cordoba, Veracruz, Mexico. (C) *O. browni*, holotype. (D) *O. batesoni*, Galapagos Islands, Ecuador.

microreticulate; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc markedly convex, densely, moderately coarsely punctate, punctures separated by thin walls. Median groove deep, wide, microreticulate. Anterior foveae absent, this region densely punctate, slightly depressed. Posterior foveae large, deep, punctate and microreticulate. Posterolateral angles with distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.00 mm; maximum width (near midlength) 0.80 mm. Disc markedly convex, with depression in midregion, moderately shiny, with six rows of round punctures between suture and humeri. Sides convex, declivity origin near midlength; intervals rounded, moderately elevated, width equal puncture width, surface smooth; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin slightly developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous,apical 0.50 with very fine, short hairs. *Legs:* Moderately long and slender; ratio of hind leg length to abdominal length 1.7:1.0. Protarsomeres 1-3 with suction setae. *Genitalia:* Male (Figs. 143A,B)(9 examined).

Variation. – The lectotype aedeagus has the apical piece shriveled slightly, but is definitely of the form I have illustrated (Fig. 143A) using a specimen from Mexico, Chiapas, 27 mi. N. Bochil. The specimens from the latter locality and lectotype have the elytral intervals somewhat less elevated than the specimens from Mexico, Cordoba. The aedeagus of the Cordoba specimen (Fig. 143B) is also slightly different, having the apical piece broader and the preterminal process directed toward the parameres. However, based upon variations in external and genitalic structure in other species which are represented by numerous specimens from many localities, I feel these two forms are conspecific, although probably diverging. Males are easily differentiated from females by the large protarsal pads of suction setae. Ten specimens were studied in addition to the lectotype (see appendix).

Natural History. – I have collected adults of this species, together with those of *Hydraena splecoma*, at the sandy margins of an overflow puddle bordering a forest stream in Mexico, Chiapas, 27 miles N. of Bochil (Figs. 190A,B).

Distribution. – (Figs. 142B,187B). Presently known only from the mountains of southern Mexico and Guatemala.

The *puncticollis* Group

Members of the *puncticollis* Group are characterized by large size (ca. 2.10–2.80 mm long) and aedeagal structure, which has the apical piece large and tapered to the apex (Figs. 144A-E). Additionally, the median portion of the aedeagus gradually tapers to its distal end and, therefore, is widest (in both dorsal and lateral views) well before the apex. Parameres are positioned in different planes, not side by side for their entire length.

The group presently includes four very distinct species. Two of these species, *O. leechi* and *O. martini*, are restricted to a few localities in California; one, *O. puncticollis*, is widely distributed in California, and known from a few localities in Baja California, Arizona and Utah; the fourth species, *O. angularidus*, is restricted to the Rio Grande River drainage in Texas and Mexico.

50. *Ochthebius puncticollis* LeConte
(Figs. 2B,D,133A,135C,144B,151D,185A)

Ochthebius puncticollis LeConte, 1852:210 (lectotype female in MCZ, here designated; type-locality: Tucson, Arizona, U.S.A). – LeConte, 1855:361. – LeConte, 1878:378. – Horn, 1890:21. – Fall, 1919:213. – Leech and Chandler, 1956:333. – Perkins, 1976:314.

The type-series in the LeConte collection at the MCZ consists of eight specimens, the first two of which have "Type 3133" labels. The first four specimens are conspecific and all are

females. The last four specimens are mounted together on a card and belong to *O. rectus* LeConte. The first specimen, a female, is lectotype, and is labelled accordingly.

Diagnosis. – The large adults included in this species are most similar to those of *O. angularidus* and *O. martini*, but differ from the former by lack of angulate lateral depressions and from the latter by lack of broadly explanate elytra (Figs. 133A,136A,C).

Description. – *Form:* Ovate, very convex (Fig. 133A). *Size:* Lectotype 2.16 mm long, 1.04 mm wide. *Color:* Dorsum dark brown with slight metallic green tint; venter dark brown, legs and palpi brown. *Head:* Length 0.46 mm; width 0.62 mm. Frons moderately densely, moderately coarsely, shallowly punctate, prominently pubescent, extremely finely microreticulate; interocular foveae deep and large, width of each 0.66 distance between them; interocular tuberculi large, basomedial foveae nearly as large as interocular foveae, shallower. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; sculpture and pubescence as frons. Labroclypeal suture straight. Labrum length 0.33 width; densely pubescent; median emargination deep, anterior 0.50 of labrum bilobed, lobes at angle to remainder of labrum. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.25 length of penultimate. Mentum width equal length, dull, densely moderately coarsely punctate, markedly microreticulate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.60 mm; maximum width (near anterior 0.33) 0.88 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin at anterior angles, extended narrowly along lateral depressions, wide at excavation, very narrow around posterior margin. Anterior margin of pronotum very slightly produced in middle, excavate in front of lateral fossulae and lateral depressions, tooth between excavations; anterior angles acute. Lateral depressions slightly inflated, broad, coarsely densely punctate, prominently pubescent; margins moderately arcuate; excavate at posterior, tooth lateral to excavation; pronotum markedly constricted behind lateral depressions. Lateral fossulae very deeply impressed, very finely microreticulate; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc moderately convex, moderately sparsely, moderately coarsely, shallowly punctate, punctures separated by one-two times puncture diameter; extremely finely, effacedly microreticulate over entire surface. Median groove long, narrow, shallow, extended from anterior and posterior border, tapered at ends. Anterior foveae large, deep, somewhat S-shaped, extremely finely microreticulate. Posterior foveae moderately large, approximately equal in size and depth to anterior foveae, somewhat teardrop-shaped. Anterior and posterior foveae of a side united by shallow groove, together in form of sinuate depression. Posterolateral angles without distinct impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with very large median glabrous area. *Elytra:* Length 1.40 mm; maximum width (near midlength) 1.04 mm. Disc convex, moderately dull, with six rows of round punctures between suture and humeri. Sides very convex, declivity origin near posterior 0.33; intervals rounded, width equal puncture width, with extremely fine, impressed lines; interstices between punctures 0.50 puncture length; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and stout; ratio of hind leg length to abdominal length 1.8:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Fig. 144B)(21 examined).

Variation. – Some specimens lack the channel joining anterior and posterior foveae. Males of this species have very small protarsal suction setae and have the lobes of the labrum moderately upturned, whereas females lack expanded protarsal setae and have the lobes slightly upturned, if at all. I have examined 219 specimens (see appendix).

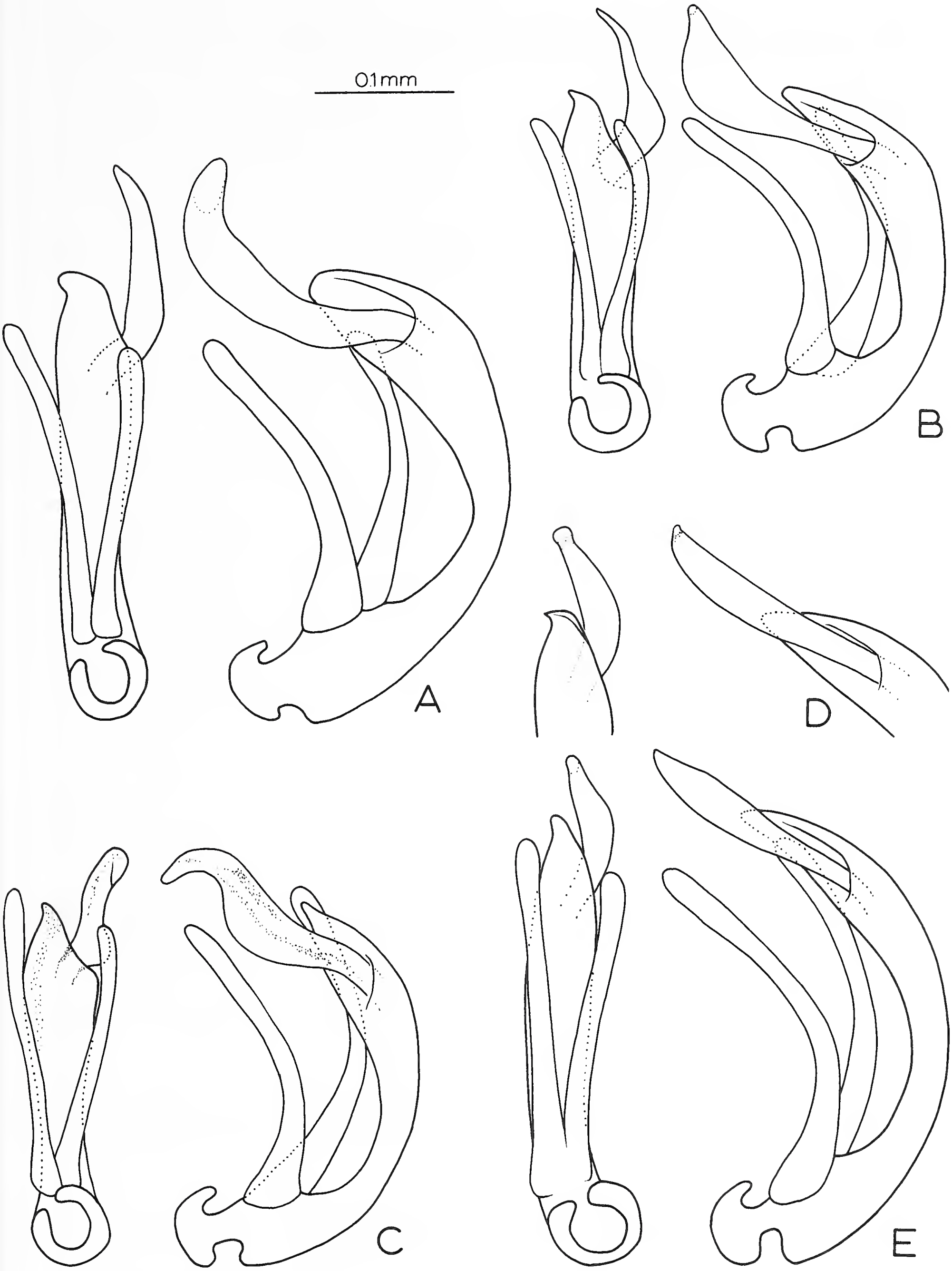
Natural History. – Specimens are typically collected at the margins of streams with sandy banks composed of well-sorted, relatively large particles. Refer to Perkins (1976) for a discussion of microhabitat preferences.

Distribution. – (Figs. 135C,185A). Southwestern United States and adjacent Baja California; in California apparently restricted to coastal mountain ranges; not yet known from the Sierra Nevada mountains.

51. *Ochthebius martini* Fall
(Figs. 135C,136C,144D,E,185A)

Ochthebius martini Fall, 1919:212 (holotype male in MCZ; type-locality: Redwood Park, California). – Leech and Chandler, 1956:333.

I have dissected the holotype, a slightly teneral male, and placed the aedeagus in a microvial affixed to the pin.



Figs. 144A – E, Aedeagi of *Ochthebius* species. (A) *O. leechi*, holotype. (B) *O. puncticollis*, Marin County, California. (C) *O. angularidus*, holotype. (D) *O. martini*, Humboldt County, California. (E) *O. martini*, holotype.

Diagnosis. – Broadly explanate elytra, convergent lateral hyaline borders and unusual habitus serve as recognition characteristics for adults of this very distinctive species (Fig. 136C).

Description. – *Form:* Broadly ovate, convex (Fig. 136C). *Size:* Holotype 2.12 mm long, 1.12 mm wide. *Color:* Dorsum and venter dark brown; legs and palpi brown. *Head:* Length 0.50 mm; width 0.66 mm. Frons sparsely punctate, markedly, extremely finely microreticulate, prominently pubescent; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi small; basomedial foveae nearly as large as interocular foveae, shallower. Frontoclypeal suture evenly arcuate. Clypeus length 0.50 width; strongly finely microreticulate; moderately pubescent. Labroclypeal suture straight. Labrum length 0.33 width; microreticulate, densely pubescent; 0.50 median emargination deep and broad, anterior 0.50 two lobes at angle to remainder of labrum. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.25 length of 3. Mentum trapezoidal, dull, microreticulate; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.68 mm; maximum width (near anterior 0.33) 0.96 mm. Anterior hyaline border wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin at anterior angles, width increased along contour of lateral depression, thence straight to posterior angles, very narrow around posterior margin. Anterior margin of pronotum very slightly produced in middle, moderately excavate in front of lateral fossulae, more deeply excavate in front of lateral depressions, pronounced tooth between excavations; anterior angles acute. Lateral depressions slightly inflated, densely coarsely punctate, moderately pubescent; margins moderately arcuate, posterior excavate, tooth lateral to excavation; pronotum markedly constricted behind lateral depressions. Lateral fossulae deeply impressed, markedly finely microreticulate; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc markedly convex, moderately coarsely, moderately densely punctate, punctures separated by one-two times puncture diameter; moderately pubescent; surface between punctures finely microreticulate. Median groove extremely narrow, shallow. Anterior foveae small, moderately deep, microreticulate, separated from median groove by 1.50 times fovea width. Posterior foveae narrow, oblique lines, microreticulate, posterior extreme of each fovea separated from median groove by four-five times fovea width. Posterolateral angles without impressions. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with very large median glabrous area. *Elytra:* Length 1.44 mm; maximum width (near midlength) 1.12 mm. Disc very convex, moderately dull, with six rows of round punctures between suture and humeri. Sides convex, declivity origin slightly past midlength; intervals flat, extremely finely microreticulate; width equal puncture width; interstices between punctures 0.25 puncture length; each puncture with seta. Explanate margin very broad. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and stout; ratio of hind leg length to abdominal length 2.0:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Figs. 144D,E)(5 examined).

Variation. – Aedeagi of specimens from Humboldt County, California differ slightly from the norm (Fig. 144D). Externally, these specimens are slightly less convex, have slightly larger pronotal foveae, and have less explanate elytra than specimens from the remainder of the range.

Natural History. – Convex body form and close phylogenetic relationship to *O. puncticollis* lead me to speculate that *O. martini* adults require streambanks with well-sorted, relatively large particles. Refer to Perkins (1976) for a discussion of the microhabitat preferences of *O. puncticollis*.

Distribution. – (Figs. 135C,185A). Restricted to the coastal mountains of northern California between Santa Cruz and Humboldt Counties.

Remarks. – This species is apparently quite rare, as a total of only 44 specimens (including holotype) were seen, despite the rather intensive collecting efforts, especially by Hugh B. Leech, in its range (see appendix).

52. *Ochthebius angularidus* new species
(Figs. 96C,136A,142A,144C,185A)

Type-locality. – Rio San Rodrigo, El Remolino near San Carlos, Coahuila, Mexico.

Type-specimens. – The holotype male and allotype with same locality data are deposited in USNM. These specimens were collected by Harley P. Brown, May 27, 1969. Data about paratypes (26) are presented in the appendix.

Diagnosis. – *O. angularidus* is readily distinguished from other New World species of the subgenus *Asiobates* by the angulate lateral depressions of the pronotum (Figs. 96C,136A).

Description. – *Form:* Ovate, moderately convex (Fig. 136A). *Size:* Holotype 2.12 mm long, 1.00 mm wide. *Color:* Dorsum and venter dark brown; legs and palpi brown. *Head:* Length 0.40 mm; width 0.56 mm. Frons rugulose, markedly microreticulate, prominently pubescent; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi large, basomedial foveae nearly as large as interocular foveae, shallower. Frontoclypeal suture slightly bisinuate. Clypeus length 0.50 width; anterior angles produced; densely, moderately coarsely punctate, punctures microreticulate; prominently pubescent. Labroclypeal suture straight. Labrum length 0.33 width; microreticulate, markedly pubescent; emargination deep, medially, lateral lobes bent at angle to remainder of labrum. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 slightly less than 0.50 length of 3. Mentum width equal length, rugulose microreticulate, prominently pubescent; anterior margin arcuate. Submentum evenly, finely punctulate, punctures contiguous. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.52 mm; maximum width (near anterior 0.33) 0.78 mm. Anterior hyaline border moderately wide in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin at produced tooth at midlength of lateral depression, extended narrowly along posterior 0.50 of lateral depression, wide at excavation, very narrow around posterior margin. Anterior margin of pronotum very slightly produced in middle, shallowly excavate in front of each lateral fossula and in front of each lateral depression, small tooth between excavations; anterior angles acute. Lateral depressions slightly inflated, broad, rugulose and prominently pubescent; margins excavate in anterior 0.50, in form of tooth at midlength of lateral depression; extreme posterior excavate, prominent tooth lateral to excavation; pronotum markedly constricted behind lateral depressions. Lateral fossulae deeply impressed, markedly microreticulate; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc rather flat, densely, moderately coarsely punctate, microreticulate within punctures, prominently pubescent; surfaces between punctures shiny. Median groove deep, broad, impunctate, markedly microreticulate. Anterior foveae large, deep, oval, width equal to distance between fovea and median groove; markedly microreticulate. Posterior foveae large, deep, markedly microreticulate. Posterolateral angles sloped. Prosternum with median carina ended at coxal cavities; coxae contiguous. Metasternum with large median glabrous area. *Elytra:* Length 1.40 mm; maximum width (near midlength) 1.00 mm. Disc convex, moderately shiny, with six rows of round punctures between suture and humeri. Sides convex, declivity origin slightly past midlength; intervals flat, width equal puncture width, surface smooth; interstices between punctures 0.25 puncture diameter; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with very fine, short hairs. *Legs:* Moderately long and stout; ratio of hind leg length to abdominal length 1.8:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Fig. 144C)(11 examined).

Natural History. – These beetles are apparently restricted to desert streams. Harley P. Brown informs me (*in litt.*) that the holotype locality was "Site of an old mill; spring-fed stream with travertine. *Lutrochus* abundant. *Psephenus texanus* present. Most abundant elmids: *Hexacylloepus*, *Microcylloepus*."

Distribution. – (Figs. 142A,185A). Northeastern Mexico and adjacent areas of Texas.

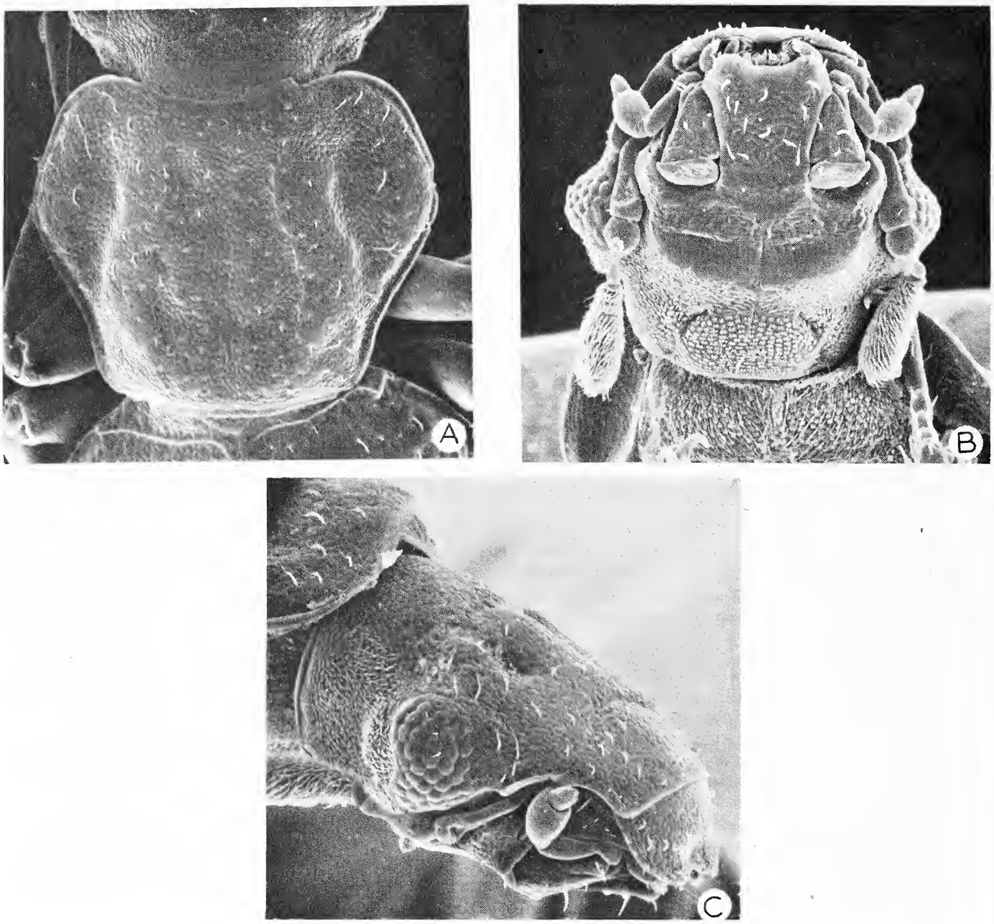
Etymology. – Latin, *angulus* (corner) plus *aridus* (dry). Named in reference to the desert habitat of this species and its angulate lateral pronotal depressions.

53. *Ochthebius leechi* Wood and Perkins
(Figs. 133C,135C,144A,185A)

Ochthebius leechi Wood and Perkins, 1978:53 (holotype male in CAS; type-locality: Salt Creek at Stony Creek, N. of Stonyford, Glenn County, California, U.S.A.)

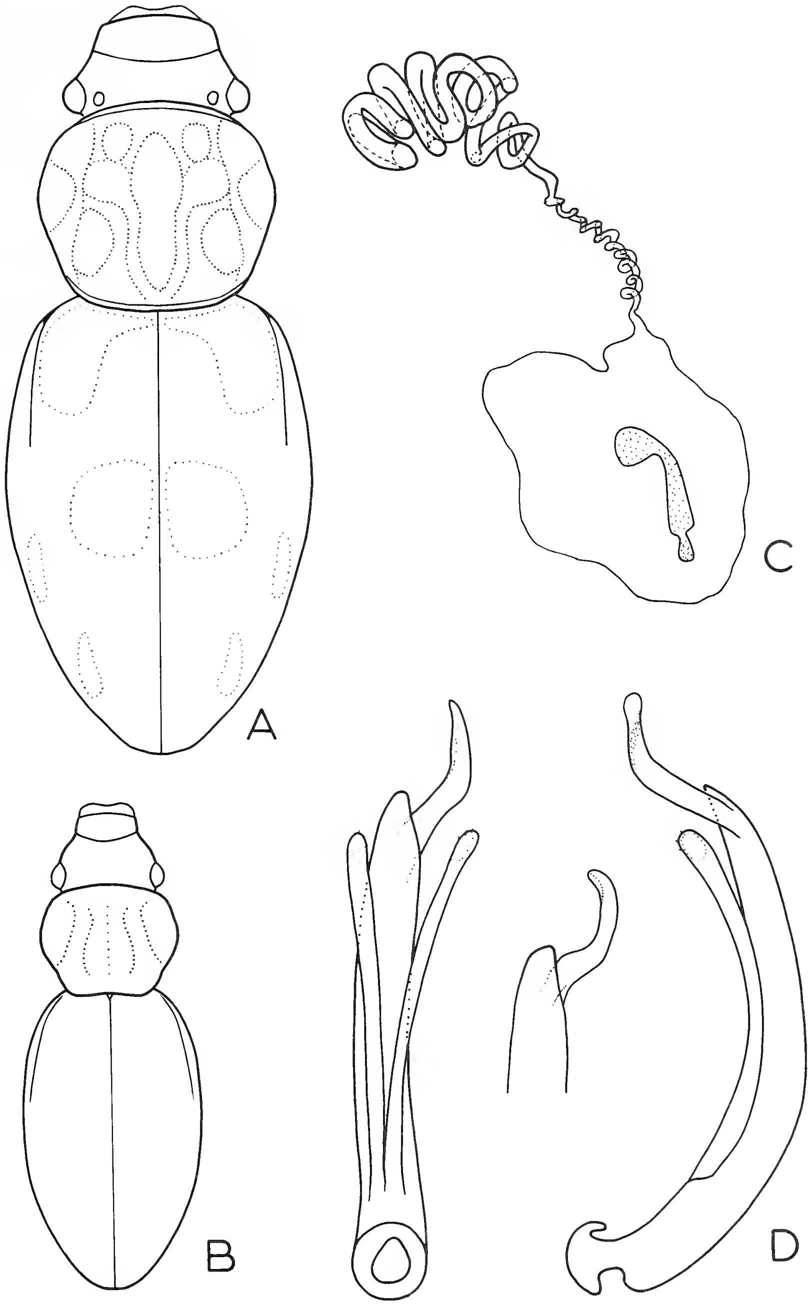
Diagnosis. – *O. leechi* adults are readily distinguished from those of the other three species in the *puncticollis* Group by absence of pronotal postocular emarginations (cf. Figs. 133A,C,136A,C). The body form of *O. leechi* is most similar to that of *O. puncticollis*, but the former is longer (2.50 vs. 2.20 mm), less convex and has a greater elytral length/pronotal length ratio.

Description. – *Form:* Ovate, moderately convex (Fig. 133C). *Size:* Holotype 2.43 mm long, 1.20 mm wide. *Color:* Dorsum dark brown to black; venter dark brown, legs and palpi brown. *Head:* Length 0.44 mm; width 0.60 mm. Frons coarsely densely punctate; interocular foveae deep and large, width of each 0.50 distance between them; interocular tuberculi indistinct, basomedial fovea contiguous with interocular foveae. Frontoclypeal suture slightly angulate. Clypeus length slightly less than 0.50 width; sculpture as frons; anterior angles slightly produced. Labroclypeal suture straight.



Figs. 145A – C, *Neochthebius vandykei.* (A) pronotum. (B) head, ventral aspect. (C) head, lateral aspect.

Labrum length 0.50 width; emargination deep, medially, lateral lobes 0.50 length of labrum, at angle to remainder of labrum. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.25 length of 3. Mentum width equal length, coarsely punctate; anterior margin arcuate. Submentum coarsely punctate. Genae shining, swollen. Postgena finely punctulate. *Thorax:* Pronotum length at midline 0.58 mm; maximum width (near anterior 0.33) 0.86 mm. Anterior hyaline border narrow in front of disc, slightly wider in front of lateral fossulae, then tapered to anterior angles. Lateral hyaline border origin at anterior angles, extended narrowly along lateral depressions, wide at excavation, very narrow around posterior margin. Anterior margin of pronotum straight, postocular emarginations absent. Lateral depressions very slightly inflated, broad, coarsely densely punctate, sparsely pubescent; margins weakly arcuate; excavate at posterior, without tooth lateral to excavation; pronotum moderately markedly constricted behind lateral depressions. Lateral fossulae deeply impressed, shallowly microreticulate; inner margin abrupt, posterior extreme tapered into lateral hyaline border. Pronotal disc slightly convex, coarsely punctate, punctures separated by puncture diameter. Median groove long, moderately wide and deep, microreticulate, tapered at ends. Anterior foveae moderately large, rugulose. Posterior foveae moderately large, shallowly impressed, microreticulate. Prosternum with low median carina ended at coxal cavities, coxae contiguous. Metasternum with very large median glabrous area. *Elytra:* Length 1.72 mm; maximum width (near midlength) 1.20 mm. Disc convex, moderately dull, with six rows of round punctures between suture and humeri; rows shallowly striate. Sides very convex, declivity origin near posterior 0.33; intervals



Figs. 146A – D. (A) *Meropathus vectis*, body outline. (B) *Neochthebius vandykei*, body outline. (C) *M. vectis*, spermatheca. (D) *N. vandykei* aedeagus, San Mateo County, California (inset: Brunswick, British Columbia, Canada).

rounded, width equal puncture width, with extremely finely impressed lines and irregularities; interstices between punctures 0.50 puncture length; each puncture with seta. Explanate margin moderately developed. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two sterna sparsely pubescent. *Legs:* Moderately long and stout; ratio of hind leg length to abdominal length 1.8:1.0. Protarsomeres 1-3 without suction setae. *Genitalia:* Male (Fig. 144A)(14 examined).

Variation. – Body length ranges from 2.40 to 2.72 mm, with most specimens approximately 2.50 mm long. Females lack the upturned labral lobes seen in males. I have examined 96 specimens (see appendix).

Natural History. – I have collected this species from the stream at Wilbur Hot Springs, Colusa County, California. The water was warm to the touch, but no temperature measurements were made. The specimens were found by stirring the substratum, which consisted of sand, pebbles and rocks. The slope angle of the bank was low, and the beetles were taken near the waterline. Elsewhere (Perkins, 1976) I have demonstrated that *O. puncticollis* lives as much as 36 inches from the waterline in stream banks with well sorted particles. I suggested that the convexity of *O. puncticollis* was one of the more important factors among the composite of biological and physical interractions which result in the observed microhabitat distributions of this species. One of the obvious differences between *O. puncticollis* and *O. leechi* is the more convex body of the former. Perhaps these two environmental factors, water temperature and substrate particle size, have played a major role in the differentiation of species in the *puncticollis* Group.

Distribution. – (Figs. 135C,185A). Northwestern California.

GENUS *MEROPATHUS* ENDERLEIN

Meropathus Enderlein, 1901:121 (type-species: *Meropathus chuni* Enderlein). – d'Orchymont, 1938a:78. – Jeannel, 1940: 129. – Brookes, 1951:28. – Gressitt and Samuelson, 1964: 376. Samuelson, 1964:624. – Janssens, 1967a:3. – Ordish, 1971:185.

Discussion. – *Meropathus* is a distinctive genus whose adults are characterized by rough elytra with ridges of various sorts and with stiff, recumbent setae which are also present on the head and pronotum. Body form (Fig. 146A) is also distinctive, as is the short metasternum.

According to current data, the genus is restricted to eastern Australia (3 species) (Janssens, 1967a), islands of the New Zealand subregion (3 species) (Brookes, 1951; Gressett and Samuelson, 1964; Ordish, 1971), and the island group consisting of Prince Edward Islands, Kerguelen Island and Heard Island (1 species) (Enderlein, 1901; d'Orchymont, 1938; Jeannel, 1940; Janssens, 1967a).

The description herein of *M. vectis*, from Isla de los Estados and the Falkland Islands at the tip of South America (Fig. 87B), constitutes the first mention of a member of *Meropathus* from the Western Hemisphere and completes the circum-polar pattern of distribution. The relative locations are such that if one draws a line connecting the insular populations, that is, from Isla de los Estados to the Kerguelen Island vicinity, to the Campbell Island vicinity, and back again to Isla de los Estados, an (approximate) equilateral triangle is formed, the center of which is very near the South Pole. Further comments on zoogeography are presented in the section on that topic.

Adults of this genus are apparently only semi-aquatic, the insular species being found in coastal areas around stones, moss, grass tussocks and bird nests, whereas available data for the Australian species indicates moist streamside habitats such as foam near waterfalls (Janssens, 1967) or debris beneath tree ferns near streams and waterfalls (Deane, 1931). For more

detailed notes on the habitat of this genus on subantarctic islands, the reader is referred to Ordish (1971). The single specimen of *M. vectis* from the Falkland Islands has the label notation, "in *Poa flabellatum* tussock"; habitat data are not available for the two specimens from Isla de los Estados.

D'Orchymont (1938a) presented a rather thorough review of structural features of *M. chuni*, to document his opinion that *Meropathus* was not of equal rank with *Ochthebius*. He, therefore, ranked the former as a subgenus of the latter while also indicating a number of similarities between *Meropathus* and *Neochthebius* (the latter he considered of subgeneric rank also).

Following his morphological treatise on *Meropathus* d'Orchymont (1938a:89) makes the following statement: "Je n'ai pu examiner l'edeage; je craignais d'abimer eventuellement par une dissection le seul male que j'ai vu et qui appartient as Museum de Paris. Il n'est pas douteux toutefois que cet organe doive etre conforme comme celue des *Ochthebius*, pourvu par consequent de deux parameres."

Two years later, much to d'Orchymont's chagrin, I would imagine, Jeannel (1940) demonstrated that the aedeagus, in fact, did lack parameres. D'Orchymont's opinion of the proper rank for *Meropathus* did not change however, as he (1943b:39) makes the following remark in a footnote: "C'est a tort que R. Jeannel vient d'accorder de nouveau rang generique a *Meropathus*. Cette appreciation est basee uniquement sur une erreur fondamentale de morphologie phallique, a savoir que las *Hydraena* seraient depourvues de parametres a l'edeage. Ceci n'est vrai que pour les *Haenydra*. Les autres, les *Hydraena (sensu stricto)* entre autres, ont au contraire des parameres bien developpes. La meme chose se presente chez *Limnebius* (*Bilimneus*) (depourvu) et *Limnebius (sensu stricto)* (pourvu de parameres). Ce qui n'empeche que ces subdivisions ne sont a considerer que comme des sou-genres."

All other authors (Brookes, 1951; Gressitt and Samuelson, 1964; Janssens, 1967; Ordish, 1971) have, nevertheless, considered *Meropathus* a valid genus (as do I), but have not attempted to resolve its position within the Hydraenidae, or even within *Ochthebius (sensu* d'Orchymont).

By the shape of the maxillary palpi, *Meropathus* is clearly closely related (within the Hydraenidae) to *Ochthebius*, *(sensu stricto)*. However, the antennae and other characteristics indicate an even closer relationship to *Neochthebius*, a relationship which d'Orchymont (1938a) recognized, but did not reflect in his ranking (refer to *Neochthebius* for additional comments). It appears, therefore, that d'Orchymont in his broad concept of *Ochthebius*, afforded equal rank (subgenera) to groups which varied in their phylogenetic proximity to *Ochthebius* (in the very strictest sense, i.e., that group which contains *O. marinus* (Paykull), the type of the genus).

It becomes evident, therefore, that the concept "*Ochthebius*" (*sensu* d'Orchymont) is used to best advantage when treated as a suprageneric category, thereby permitting equal ranking to lineages which appear, based upon many considerations from which phylogeny is inferred, to warrant that ranking (refer to the sections on phylogeny for additional comments).

1. *Meropathus vectis* new species
(Figs. 87B,146A,C,151A,B)

Type-locality. – Puerto San Juan, Isla de los Estados, Argentina.

Type-specimens. – The holotype female is deposited in USNM. One female paratype from Bahia Blossom on the same island is also deposited in USNM. These two specimens were collected by O.S. Flint and G.F. Hevel May, 1971. One additional female paratype, deposited in BMNH, has the following data: E. Falkland Is., Kidney Is., 30-XI-1961, M. Holdgate, in *Poa flabellatum* tussock.

Diagnosis. – Adults are intermediate in development of dorsal roughness and pubescence between the very rugose, strongly pubescent adults of *M. campbellensis* Brookes (Campbell Island) and the smoother, less pubescent adults of *M. chuni* Enderlein (Kerguelen Islands). *M. vectis* may be distinguished from *M. campbellensis* by the following: 1) borders of the pronotal median depression are costiform and with long hairs which form distinct lines in *M. campbellensis*, whereas the borders in *M. vectis* are rounded, with much shorter hairs which do not form distinct lines; 2) the median depression is rugose in *M. campbellensis*, microreticulate in *M. vectis*; 3) the elytra of *M. campbellensis* have three pubescent tubercles on the suture, one just behind the scutellum, one at midlength, and one at the apical 0.25, *M. vectis* lacks these tubercles. *M. chuni* can be distinguished from the previous two species by the cariniform elytral suture and much reduced dorsal pubescence.

Description. – *Form:* Elongate oval, convex (Fig. 146A). *Size:* Holotype 2.32 mm long, 1.00 mm wide. *Color:* Black. *Head:* Length 0.40 mm; width 0.68 mm. Frons semi-rugulose, moderately pubescent on reliefs; interocular foveae deep, width of each 0.50 distance between them; interocular tuberculi large, pubescent. Frontoclypeal suture bisinuate. Clypeus length nearly 0.33 width, microreticulate. Labroclypeal suture straight. Labrum length 0.50 width; surface much smoother than clypeus, shining; anterior emargination nearly 0.25 length of labrum. Maxillary palpus with palpomere 3 moderately wide; palpomere 4 0.75 length of 3. Mentum rectangular width 0.61 length, finely microreticulate. Submentum finely punctulate. Genae swollen in midregion, depressed laterally, punctulate. Postgena punctulate. *Thorax:* Pronotum length at midline 0.66 mm; maximum width (near anterior 0.33) 0.86 mm; moderately pubescent on reliefs, markedly microreticulate, semi-rugulose throughout; anterior margin straight, with thin semi-transparent border; median depression wider in anterior 0.50, margins rounded; large tubercle each side of posterior 0.50 of median depression; large tubercle and oval depression on each side of anterior 0.50 of median depression; posterior margin slightly arcuate to rear, with thin semi-transparent border. Prosternum shallowly depressed in front of coxae; coxae contiguous. Metasternum depressed in midline, hydrofuge pubescent. *Elytra:* Length 1.20 mm; maximum width (near midlength) 0.80 mm. Wings absent, elytra interlocked. Each elytron with large, deep depression median to humerus and shallower, smaller one at midlength near suture. Margin and much of surface with thick hook-shaped setae. Each elytron with two low tubercles in posterior 0.50. Explanate margin well developed, especially near apices. *Abdomen:* Sterna hydrofuge pubescent. Hairs on sternum 6 much longer than those of other sterna. *Legs:* Of moderate length and build. *Genitalia:* Male unknown; female (Fig. 146C)(3 examined) (note: the spermatheca illustrated is from the Falkland Island specimen, which was the best preparation of the three).

Variation. – The specimen from the Falkland Islands is slightly more pubescent and has the elytral tubercles somewhat larger than the two specimens from Isla de los Estados. Aedeagi of males from both localities must be studied to determine with certainty that these two populations are not conspecific.

Natural History. – The specimen from the Falkland Islands was found "in *Poa flabellatum* tussock".

Distribution. – (Fig. 87B). Isla de los Estados, Argentina, and the Falkland Islands.

Etymology. – Latin, *vectis* (rider). This species has reached its present distribution by riding on either marine birds or drifting land masses, probably the latter.

GENUS *NEOCHTHEBIUS* D'ORCHYMONT

Neochthebius d'Orchymont, 1932a:42 (type-species: *Ochthebius vandykei* Knisch; new status). – Van Dyke, 1918:306. – Knish, 1924:31. – d'Orchymont, 1932a:42. – d'Orchymont, 1938a:83. – Leech and Chandler, 1956:333. – Hatch,

1965:20.

Discussion. – D'Orchymont (1932a) established a new subgenus, *Neochthebius*, for the unusual intertidal hydraenid, *Ochthebius vandykei* Knisch. This unusual beetle is distributed along the Pacific Coast of North America from British Columbia to southern California (Fig. 139C), living in crevices of rocks in the intertidal zone (Van Dyke, 1918). It is the only Western Hemisphere hydraenid occupying such a habitat. The Japanese species, *Ochthebius granulosus* Satô 1963, also a member of *Neochthebius*, is closely related to *N. vandykei* and is also a member of the intertidal fauna. D'Orchymont (1932a) compared *Neochthebius* to *Cobolius, Acanthochthebius, Doryochthebius* and *Calobius*, all of which he considered subgenera of *Ochthebius*. (Janssens (1969) has subsequently combined *Doryochthebius* and *Calobius*– see section on *Ochthebius*).

However, in a later paper detailing his reasons for ranking *Meropathus* as a subgenus, d'Orchymont (1938a) compared *Neochthebius* closely to *Meropathus* and contrasted them both to *Henicocerus* (all of which he considered of equal, subgeneric rank).

Similarities between adults of *Neochthebius* and *Meropathus* which d'Orchymont emphasized were the antennae and, in passing, the short metasternum and short, stout tarsi. The antennae of the two groups are very similar, having a characteristic globose shaped antennomere 2 (Figs. 145B,C). In addition to the short metasternum, the eyes of both groups are much smaller than other *Ochthebius* (*sensu* d'Orchymont) and have larger, more convex facets (Figs. 145B,C). Additionally, both groups are apterous and have 1) a markedly microreticulate, median longitudinal depression on the pronotum, 2) rugulose elytra which are fused at the suture, 3) reduced metanotum, and 4) short, stout tarsi. In fact, even the body form of *Neochthebius* and *Meropathus* (Figs. 146A,B) are very suggestive of a close relationship. Add to these morphological resemblances the similarities in habitats of *Neochthebius* (intertidal) and *Meropathus* (coastal), and the close relationship becomes almost undeniable.

The more highly derived character states of *Meropathus*, however, make the two groups quite dissimilar. The most obvious difference is development of dorsal sculpture and pubescence in *Meropathus*, which has elevated carinae and mounds on the elytra and pronotum covered with stiff, recumbent setae. *Neochthebius* adults (Fig. 145A) are much less markedly sculptured, and much flatter. Finally, differences in the aedeagus between males of *Neochthebius* (with parameres) and *Meropathus* (lacking parameres), validate separate generic status for the two groups.

From the features described above, many of which are obviously of a derived nature, it is apparent that *Neochthebius–Meropathus* form a sub-lineage within *Ochthebius (sensu* d'Orchymont), whereas the other subgenera of the group (e.g., *Ochthebius, Asiobates, Henicocerus, Calobius*, etc.) form another, larger sublineage.

Males of all subunits of *Ochthebius (sensu* d'Orchymont), except *Meropathus*, have parameres, however, this being a plesiotypic state it cannot be used to unite *Neochthebius* to the other subunits with this non-derived condition.

Recognizing *Neochthebius* and *Meropathus* of equal (generic) rank with *Ochthebius* reflects the two monophyletic lineages (*Ochthebius* and *Neochthebius–Meropathus*) and also emphasizes the divergence of *Meropathus*. (Formally naming the suprageneric groups represented by the two lineages is, in my opinion, unnecessary at this time). Additionally, it predicts absence of transitional stages between *Neochthebius* and *Meropathus*, while indicating lack of evidence for two discrete lineages within *Ochthebius*. Should further study reveal constant morphological features from which could be inferred two major lineages arising

basally within *Ochthebius* then both sublineages would warrant equal (generic) ranking with *Meropathus* and *Neochthebius (Asiobates* may be such a sublineage – refer to the discussion section of *Ochthebius).*

That the sublineage *Neochthebius–Meropathus* has its origin basally in the broader lineage is inferred from the austral Gondwanian pattern of distribution of *Meropathus* (see sections on *Meropathus* and phylogeny).

1. *Neochthebius vandykei* (Knisch) (Figs. 139C,145A-C,146B,D,198A-C)

Ochthebius vandykei Knisch, 1924:31 (*nomen novum*). – d'Orchymont, 1932:42. – d'Orchymont, 1943:40. – Leech and Chandler, 1956:333.

Ochthebius lapidicolus Van Dyke (not Wollaston), 1918:306 (holotype female in CAS; type-locality: Moss Beach, San Mateo County, California).

Diagnosis. – This small blackish species is easily distinguished by virtue of its narrow body form, dull, strongly microreticulate dorsum, and intertidal habitat.

Description. – *Form:* Elongate. *Size:* Holotype 1.64 mm long, 0.60 mm wide. *Color:* Dorsum and venter dull black, legs dark brown. *Head:* Length 0.30 mm; width 0.42 mm. Frons markedly microreticulate; interocular foveae deep and large, width of each nearly 0.66 distance between them; interocular tuberculi very small; basomedial fovea very shallow. Frontoclypeal suture evenly arcuate. Clypeus strongly microreticulate, length 0.50 width. Labroclypeal suture straight. Labrum microreticulate, length 0.50 width; median emargination shallow. Maxillary palpus with palpomere 3 short, wide; palpomere 4 nearly 0.66 length of 3. Mentum longer than wide, shiny, microreticulate; anterior margin arcuate. Submentum microreticulate. Genae dull, swollen. Postgena finely punctulate. Eyes small, facets relatively large. *Thorax:* Pronotum (Fig. 145A) length at midline 0.44 mm; maximum width (near anterior 0.33) 0.50 mm. Anterior hyaline border very narrow, slightly arcuate to rear. Lateral hyaline border absent. Posterior hyaline border very narrow. Anterior margin of pronotum very slightly arcuate to rear; anterior angles obtuse. Lateral depressions wide, slightly convex, markedly microreticulate. Lateral fossulae moderately deeply impressed, with well developed microreticulation; inner margin abrupt. Pronotal disc markedly microreticulate, with lyre-shaped impression and faint median longitudinal depression. Posterolateral angles with shallow impressions. Prosternum with low median ridge; coxae narrowly separated. Metasternum with small median glabrous area. *Elytra:* Length 1.04 mm; maximum width (near midlength) 0.60 mm. Disc dull, rugulose, with ill-defined rows of punctures, each puncture with distinctive decumbent seta. *Abdomen:* Basal five sterna with hydrofuge pubescence. Apical two segments smooth, basal 0.50 glabrous, apical 0.50 with fine hairs. *Legs:* Moderately long and stout. *Genitalia:* Aedeagus as illustrated (Fig. 146D)(10 examined).

Variation. – Specimens from British Columbia are generally larger (about 1.72 mm long) and more markedly sculptured than those from California. The aedeagal apex (Fig. 146D) of British Columbia morphs differs very slightly from that of California morphs. Sexes of this species are differentiated by the row of stout spines bordering the last abdominal segment of females; these spines are absent from males.

Distribution. – (Fig. 139C). Intertidal zone of rocky coastlines from British Columbia to southern California. I have examined 257 specimens (see appendix).

PHYLOGENETIC RELATIONSHIPS AND ZOOGEOGRAPHY

Phylogenetic Relationships of the Family

Phylogenetic placement of the family Hydraenidae is currently a matter of disagreement as certain structures are similar to those of the Hydrophiloidea, whereas others seem to indicate relationship to primitive families of the Staphylinoidea (especially the Ptiliidae).

Based upon adult antennal form, aquatic habits, and metendosternite, relationships appear to be with the Hydrophiloidea. The wings, however, are similar to Staphylinoidea, and larvae

markedly resemble those of the Ptiliidae.

This situation provides an example of the difficulties in differentiating similarities due to plesiotypy or convergence from those due to apotypy (see Hennig, 1966). Proponents of hydrophiloid relationships for the Hydraenidae suggest that wing and aedeagal structure are convergent with staphylinoids, a by-product of body size reduction; and larval resemblance is considered a result of retention of primitive form. Those coleopterists more inclined to place the hydraenids in the staphylinoid lineage propose that aquatic habits of adults and antennal form are both a result of convergence with hydrophiloids.

Dybas (1976), in a fine paper on ptiliid and limulodid larvae, has reviewed the literature on this topic, as has Crowson (1955). I refer the reader to those papers for background information. Presentation of new data is beyond the scope of this present contribution.

Dybas (1976) has emphasized the "fimbriate galea" in common between larvae of certain genera in the Ptiliidae (and related staphylinoids) and certain genera in the Hydraenidae. He considers the fimbriate condition apotypic for these families and states, "Though there has been lack of agreement as to the systematic position of the family Hydraenidae, I regard it as clearly belonging in the Staphylinoidea because of the characters of the larva (particularly the maxilla of *Hydraena*) and because of the close resemblance in numerous features of the dorsum of the abdomen of the adult to that of the generalized ptiliid *Nossidium* (unpublished data)." He considers the absence of a fimbriate galea in certain lineages of both ptiliids and hydraenids as secondary.

On the other hand, Crowson (1955) states that hydraenid "..relationship to the Hydrophiloids is indicated by the Palpicorn type of antenna and general aquatic adaptations", and considers the larval mouthparts "undoubtedly primitive".

It is evident that phylogenetic relationships of the Hydraenidae remain equivocal, a fertile area for further research.

Phylogenetic Relationships of the Genera

Little has been written about phylogenetic relationships within Hydraenidae, the few papers embracing the topic being of a narrative variety. Cladograms have not been published and no studies have been presented whose specific intent was to distinguish between apotypic and plesiotypic character states (see Hennig, 1966).

Even the first internal grouping of taxa in the family, resulting in *Limnebius* on the one hand and *Hydraena–Ochthebius* on the other, has been accepted by all previous authors without rigorous examination. This arrangement results from the different facies of *Limnebius* adults, which lack constricted posterior sides on the pronotum seen in adults of *Hydraena* and *Ochthebius* (cf. Figs. 21A,69A,96A). Using only this difference for separating *Limnebius*, and likewise uniting *Hydraena* and *Ochthebius*, dates at least to Mulsant (1844) in his "Hydraeniaires" and "Limnebiaires". The different facies even prompted Thomson (1859) to place *Limnebius* in a family "Limnebiidae" and *Ochthebius* plus *Hydraena* in the "Ochtebiidae".

This first subdivision, and the character upon which it is based, was followed by d'Orchymont (1916) in his original paper on the phylogeny of the "Palpicornia" (Hydrophilidae *sensu lato*), in which he placed *Hydraena* plus *Ochthebius* in the subfamily Hydraeninae and *Limnebius* in the subfamily Limnebiinae (and also included *Spercheus* in the Hydraenidae). In his catalogue of Indian insects, d'Orchymont (1928) again used this character. Likewise, Knisch (1924) used this subdivision, and the names Hydraeninae and

Limnebiinae. Leech (in Leech and Chandler, 1956) also used the different facies in his key to the subfamilies, but added the difference in lengths of hind tarsomere 2: longer than 3 in *Limnebius* and about as long as 3 in Hydraeninae.

F. Balfour-Browne (1958) presents perhaps the most aberrant view (among recent authors) considering the first division of the Hydrophilidae (in the broadest sense) to form the Sphaeridiinae (terrestrial hydrophilids) and all others (including hydraenids) in the Hydrophilinae (this approach originating, at least in part, from his view that larvae should not be considered equally with adults when attempting to reconstruct relationships). He, nevertheless, united *Hydraena* and *Ochthebius* ("The *Hydraena–Ochthebius* Group") in one section and presented *Limnebius* in a separate section, again reflecting the supposed dichotomy.

Although *Hydraena* and *Ochthebius* adults are similar to one another in general facies, is this resemblance due to synapotypy or to plesiotypy? Heads, including the maxillae and head capsule itself, the pronota, and the metasterna of these two genera differ rather markedly.

In comparison with Hydrophilidae, the elongate body form with pronotum constricted at the rear is characteristic of *Hydrochus* and *Helophorus* adults, two genera commonly accepted (on the basis of larval structure especially) as retaining more primitive characteristics among the hydrophilids, whereas the more derived genera of hydrophilids have the body more ovate and sides evenly rounded as in *Limnebius*. In fact, it is the resemblance of *Limnebius* to the higher hydrophilids that prompted early workers (Erichson, 1837) to place *Limnebius* in that group. Many other characters (larval, aedeagal, etc.) reveal that *Limnebius* rightly is a member of the hydraenid lineage, and that the superficial resemblance of adults to higher hydrophilids is a result of convergence (this smooth dorsal habitus is a commonly derived condition, characteristic of adults of Hydroscaphidae, Ptiliidae, Staphylinidae, Phalacridae, etc.).

Similarity in facies displayed by adults of *Hydraena* and *Ochthebius* is therefore very probably due to inheritance of an ancestral condition (plesiotypy), not synapotypy, and cannot be used as evidence of relationship.

Consequently, in my study of structure of adults and larvae of the various genera in this family, I have not assumed *a priori* that *Limnebius* represents a lineage separate from the remainder of the family, and that *Hydraena–Ochthebius* is necessarily a monophyletic assemblege. The only two previous publications concerned directly with phylogenetic relationships within the Hydraenidae, (at the generic level), d'Orchymont (1936A) and Janssens (1965), omit *Limnebius* from consideration.

D'Orchymont (1936a) tabulated his conclusions regarding relationships between the various subgenera of *Hydraena*. However, he did not distinguish between primitive and derived character states, other than to note that loss of parameres from *Haenydra* males was secondary and monophyletic, whereas reduced number of distinct elytral series of punctures in the same subgenus was "à rattacher directement à la souche" of *Hydraena*. (Zwick (1977) has commented, "*Haenydra* is almost certainly not the great evolutionary alternative to *Hydraena (sensu stricto)*, and the other subgenera,..", but did not present data to validate his opinion.)

Janssens (1965) is the only author who has attempted to consider phylogeny of the Hydraenidae on a broader scale, that is, by including a number of the genera (but excluding *Limnebius*). The primary feature which he compared between *Ochthebius*, *Laeliaena, Hydraenida, Parhydraena* and *Hydraena* was relative lengths of the maxillary palpi, which become increasingly longer in the sequence as stated. The remainder of his discussion, however, emphasized the diversity of *Ochthebius*, and when comparing *Ochthebius granulatus* with *Hydraena griphus* he stated, "Mais peut-on dire que l'une de ces deux formes soit plus évoluée

que l'autre? Ou que la genre *Ochthebius* soit plus (or moins) évolué que la genre *Hydraena*". He did not present a phylogram of the family nor did he discuss common ancestry of the various genera.

Janssens' point concerning lengths of the maxillary palpi of the various genera is well taken, but needs to be pursued in more depth. Ratios formed by dividing length of palpi by length of antennae (P/A), can be used to construct a morphocline of palpus development. Values for the ratio for four species in four genera are as follows: *Ochthebius tubus*, 0.61; *Parhydraenida reichardti*, 0.78; *Limnebius sinuatus* 1.20; and *Hydraena circulata*, 2.00 (I believe that the species selected are representative of their respective genera). Based upon this criterion, *Limnebius* is between *Parhydraenida* and *Hydraena*.

Discovering other features which can be used to form morphoclines is more difficult, since, as Janssens (1965) has emphasized, the genera are very diverse and divergent one from the other (especially in the adult stage). There are, however, additional morphoclines which can be used in phylogeny reconstruction, and also presumed synapotypies for both adults and larvae. These are discussed below and used in a phylogram (Fig. 147; numbers on phylogram correspond to those morphoclines and synapotypies listed below). (In the discussion below, the term "united" is used when two groups share an apotypic character state.)

A. Morphoclines

1. Reduction of gula, and related modifications to the tentorium in adults.
2. Development of closed procoxal cavities in adults.
3. Increasing ratio of maxillary palpus/antenna length in adults.

B. Synapotypies

4. *Hydraena–Limnebius* united by antennal sensilla of larvae.
5. *Hydraena–Limnebius* united by form of labral setae in larvae.
6. *Hydraena–Limnebius* united by form of urogomphi in larvae.
7. *Hydraena–Limnebius* united by loss of ocelli in adults.
8. *Hydraena–Limnebius* united by possession of plate–like structure at base of maxillary palpus in adults.
9. Fimbriate galea in adults of *Hydraena* lineage.
10. Stoutly spined lacinia in adults of *Ochthebius* lineage.
11. Non–fimbriate galea in larvae of *Ochthebius* lineage.
12. Development of pronotal hyaline borders in adults of *Ochthebius* lineage.
13. *Ochthebius–Meropathus–Neochthebius* united by form of aedeagus.
14. *Neochthebius–Meropathus* united by fused elytra, form of metasternum, body form, and habitat.
15. *Hydraenida–Parhydraenida–Coelometopon* united by form of head, number of antennal segments, form of metasternum, and habitat.
16. *Hydraena–Spanglerina* united by elongate maxillary palpi of adults.
17. *Limnebius–Laeliaena* united by smooth body form.

Resemblances between genera of different lineages resulting from symplesiotypies and convergences, such as possession of ocelli, similar body form, aedeagus lacking parameres, etc., are discussed below, or have been discussed in previous sections. None of the above data bits provide conclusive evidence for monophyly or of the branching sequence which I propose, rather the cumulative effect of these bits of information give credence to the proposed phylogeny as a whole. Moreover a number of these topics require further research, this phylogeny being preliminary and subject to revision as new data become available. Differences

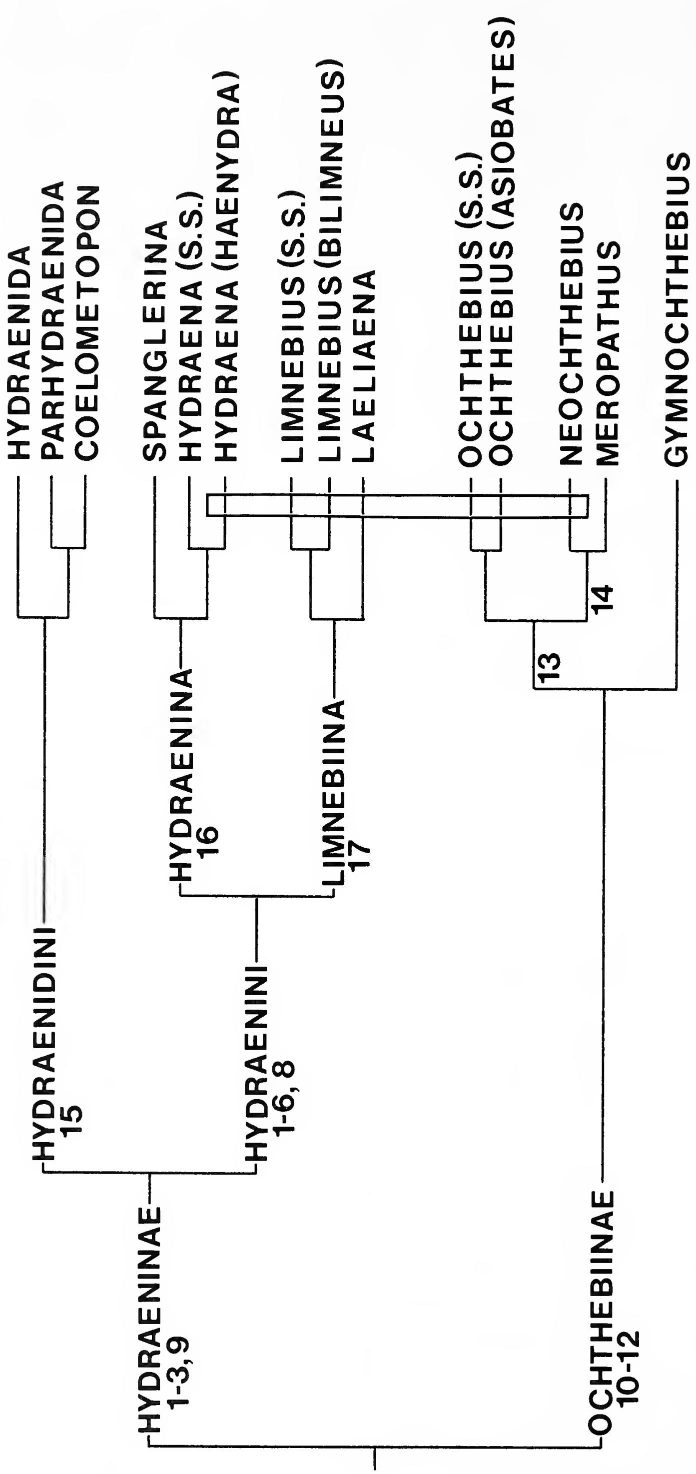
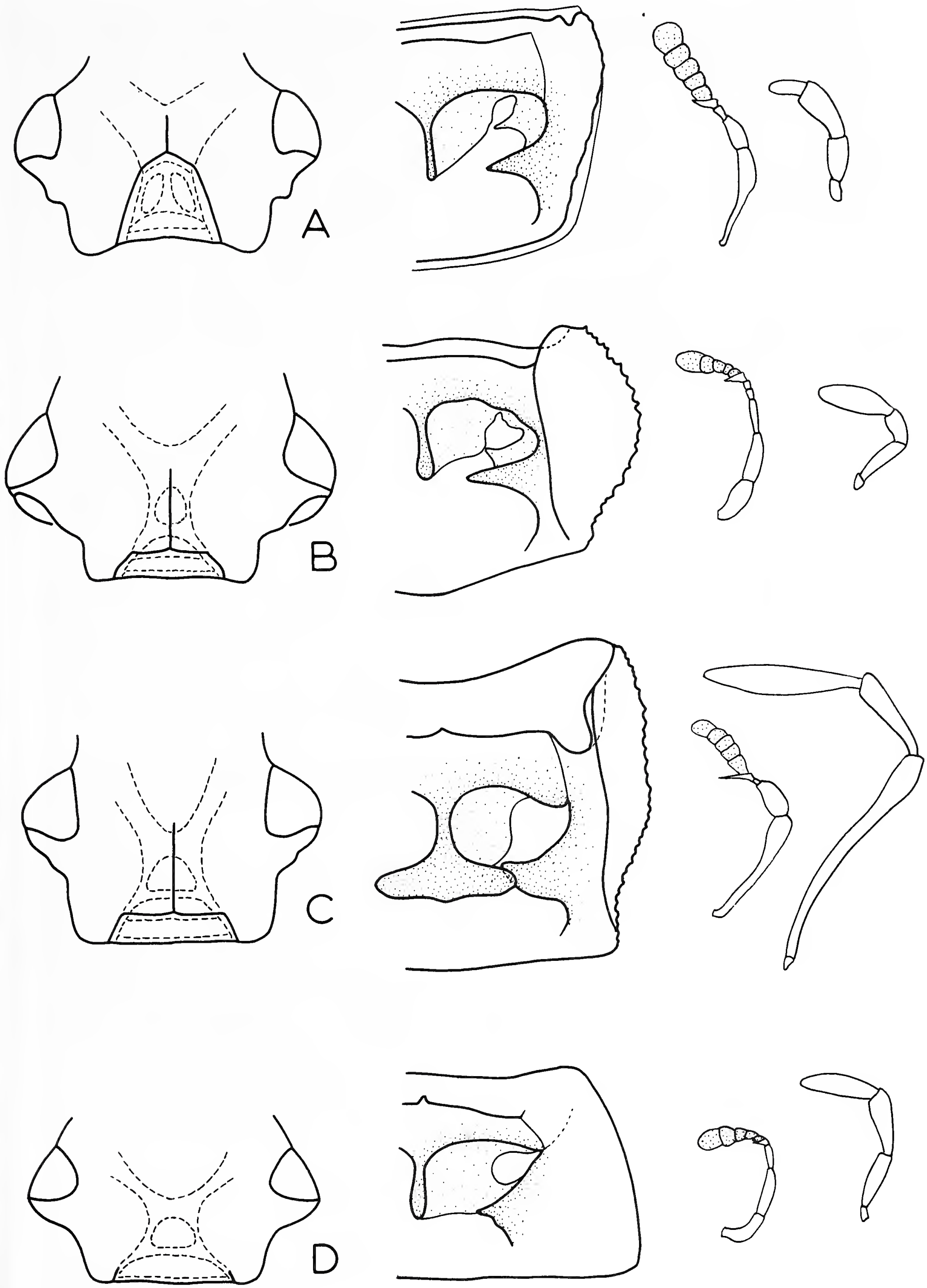
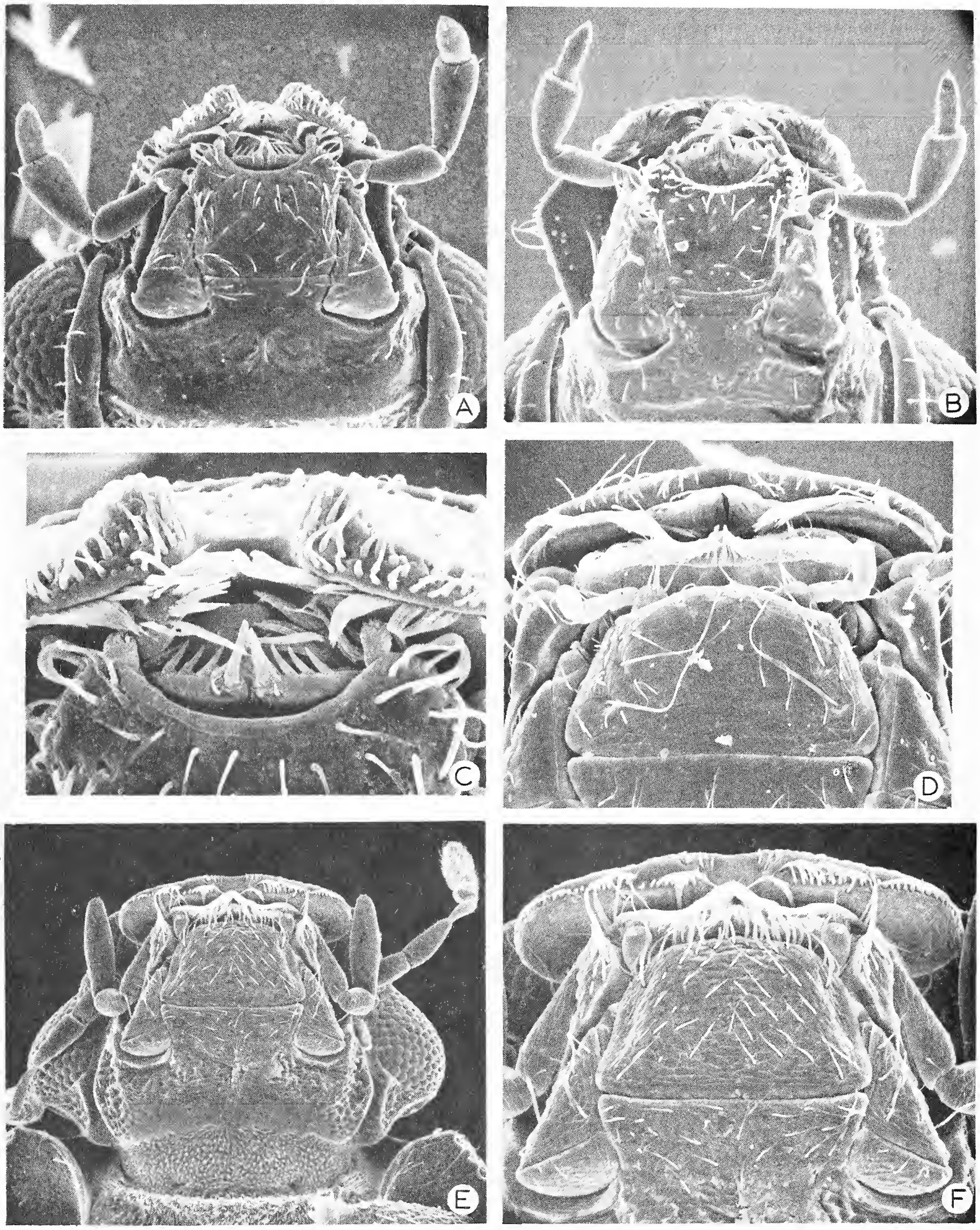


Fig. 147. Proposed phylogeny of supraspecific taxa of Hydraenidae. Numbers refer to morphoclines and derived character states discussed in text. Rectangle distinguishes taxa of Laurasian origin (inside) from Gondwanian (outside).



Figs. 148A – D, Head, prosternum, antenna and maxillary palpus. (A) *Ochthebius tubus*. (B) *Parhydraenida reichardti*. (C) *Hydraena circulata*. (D) *Limnebius sinuatus*.



Figs. 149A – F, Head, ventral aspect. (A) *Ochthebius tubus*. (B) *Gymnochthebius clandestinus*. (C) *O. tubus*. (D) *Limnebius sinuatus*. (E–F) *Parhydraenida reichardti*.

between closely related genera are discussed elsewhere in the text and summarized in the key to genera.

1. Reduction of gula, and related modifications to the tentorium of adults. – The genera *Ochthebius*, *Meropathus*,*Neochthebius*, *Gymnochthebius* and *Tympanogaster* (Australian) have a large, triangular gula with a relatively short median gular suture (Fig. 148A), whereas in *Hydraena*, *Hydraenida*, *Parhydraenida* and *Coelometopon* (African) the gula is much smaller, apparent as a narrow transverse sclerite at the rear of the head, and the median gular suture is longer than in the *Ochthebius* group (Figs. 148B,C). The morphocline is completed in *Limnebius*, which lacks both gular sclerite and median gular suture (although there may be a weak impression in adults of some species), but retains remnants of the lateral gular sutures (Fig. 148D).

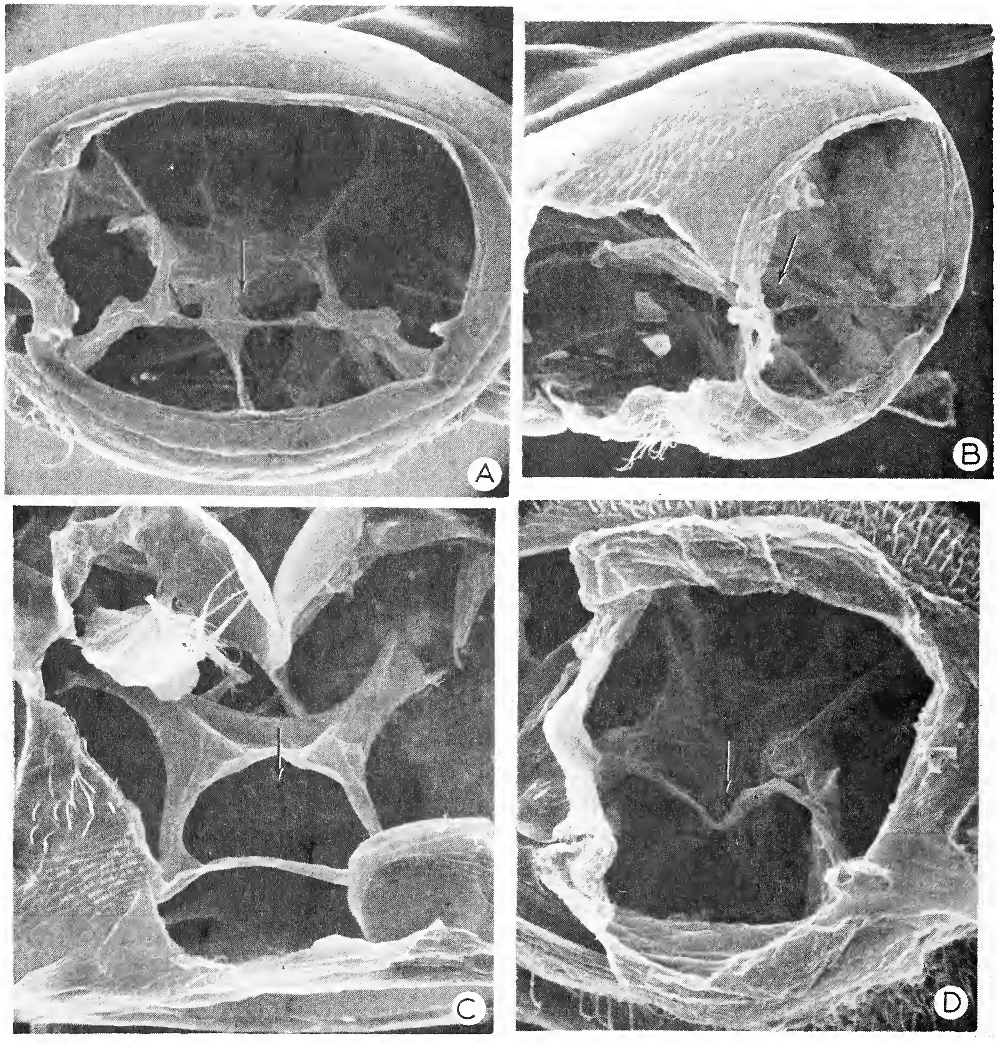
To see these features in their entirety the head must be cleared of tissue with hydroxide solution and the pigment partially removed with hydrogen peroxide. When an untreated specimen is viewed with reflected light, the gular sclerite of *Ochthebius* and allied genera is readily apparent (Figs. 103C,128C,145B,152A,B), whereas in *Hydraena*, *Hydraenida* and *Parhydraenida* the transverse gular sutures may be evident in lightly colored species, but the most prominent external manifestations are the invaginations (apodemes) marking the lateral limits of the sclerite (Figs. 21H,57A,63G,65D,149E). In *Limnebius* there is only the slightest indication of the lateral gular sutures, and these are generally hidden beneath the anterior edge of the prosternum in dried specimens (Figs. 152C,D).

These differences in the gular sclerite are related to rather marked differences in form of the tentorium. The tentorium of *Ochthebius* and allied genera (*Gymnochthebius*, *Meropathus*, *Neochthebius*) (Figs. 151A,B,D) forms a complete enclosure around the subesophageal ganglion. The anterior "wall" of the tentorium provides the muscle attachment site for some of the muscles which move the mouthparts. In the center of the "wall" is a small foramen through which nerves pass connecting the ganglion and the anterior part of the head. The larger foramen through which nerves pass connecting the brain and subesophageal ganglion is divided by a narrow portion of the tentorium.

In *Hydraena* and *Parhydraenida* the tentorium (Figs. 150D,151C) lacks the complete anterior "wall", this structure being reduced to a low transverse ridge (arising from the transverse gular suture) near the rear of the head. Some of the muscles which move the mouthparts are attached to this ridge, and are, therefore, longer than the homologous muscles in the head of an *Ochthebius* (etc.) of comparable size. Since these muscles attach closer to the rear of the head, a major portion of the subesophageal ganglion is on top of the muscle fibers, in contrast to *Ochthebius* (etc.) where the anterior "wall" of the tentorium completely separates the muscles and the ganglion. Further, the foramen through which nerves pass connecting the brain and subesophageal ganglion is a single opening, not divided as in the *Ochthebius* group.

The structure in *Limnebius* (Figs. 150A-C) is very similar to the *Hydraena–Parhydraenida* type, except that the anterior "wall" of the tentorium is now contiguous with the posterior margin of the head, which, again, provides the site for muscle attachment. Therefore, the muscles completely separate the subesophageal ganglion from the ventral part of the head capsule. The remainder of the tentorium is very similar to that of the *Hydraena–Parhydraenida* type.

Differences in lengths and to a certain degree mass of muscles (more mass in *Ochthebius*) between these three types, and especially between *Ochthebius* (*et cetera*) and the others taken together is interesting. Perhaps it relates to form of maxillae, which are much stouter and of the

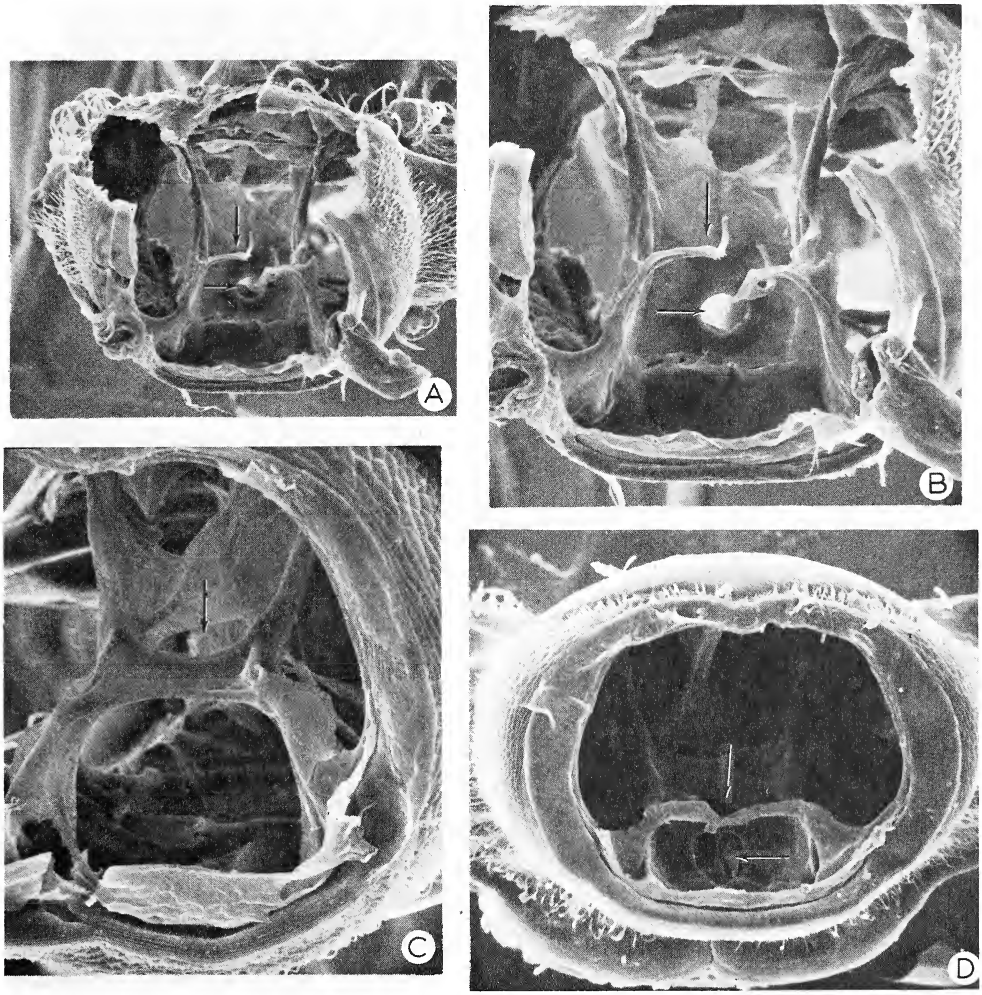


Figs. 150A – D, Tentorium (arrows indicate opening through which nerves pass between brain and subesophageal ganglion). (A–C) *Limnebius sinuatus*. (D) *Hydraena atlantica* (some distortion due to hydroxide treatment).

scraping, rasping type in the *Ochthebius* group (Fig. 98F), but more of the gathering type in the other genera (Figs. 153A-H). Then again, if a certain muscle length were necessary to function properly, having the attachment at the rear of the head would allow the head to become shortened, as in *Limnebius*.

That a morphocline is indicated should be evident from the above discussion, but what is the direction of change? Based on out-group comparisons, (see Maslin, 1952; Hennig, 1966), direction of this morphocline must be from the more developed gular sclerite and tentorium to the less developed (i.e., reduction) since both the Hydrophilidae and Staphylinidae have a well developed gular sclerite in adults.

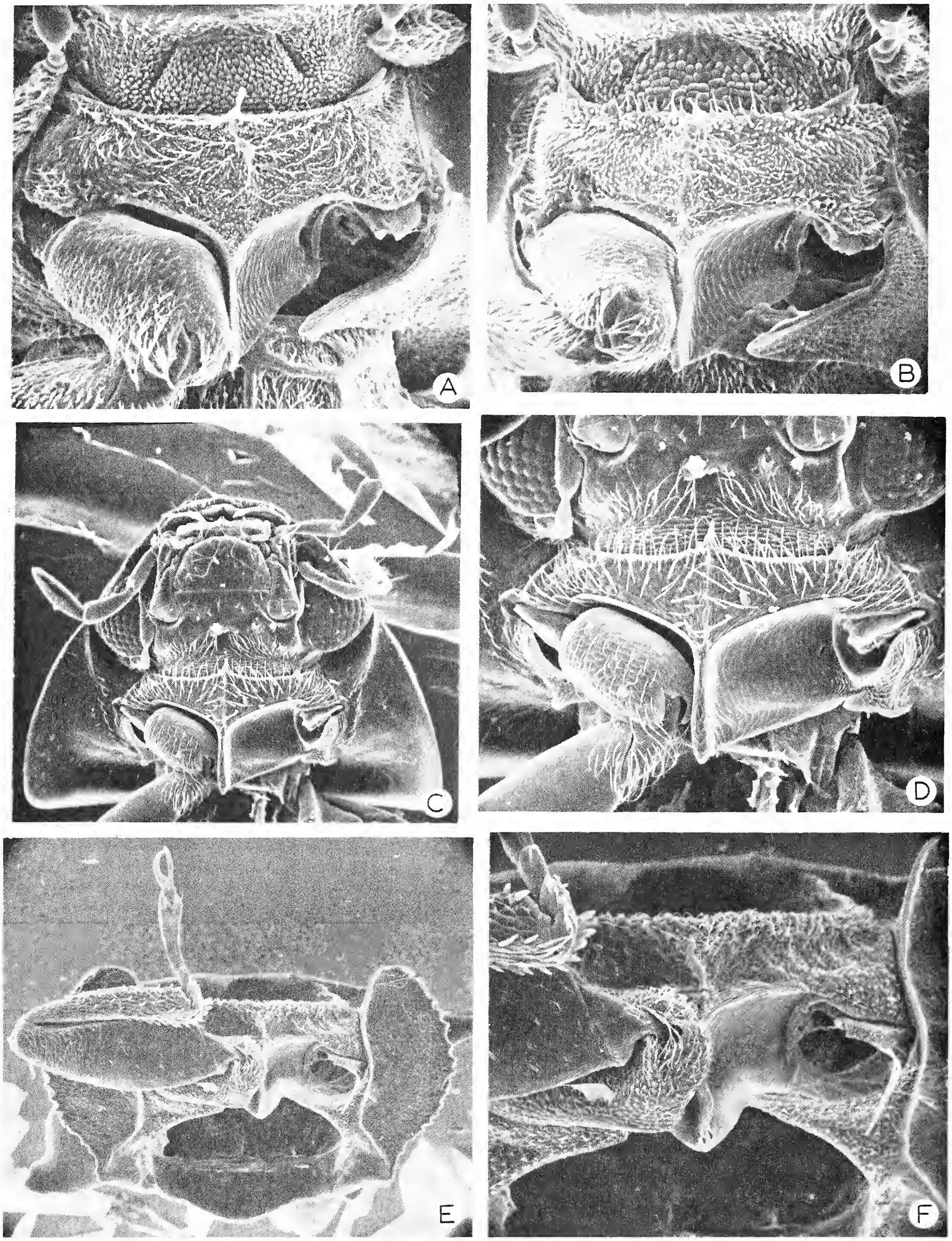
2. Development of closed procoxal cavities in adults.— The procoxal cavities vary considerably within the family, differences occurring in degree of development of the (1) coxal cavity base, (2) intercoxal process, and (3) proepisternum. The coxal cavity base exhibits a



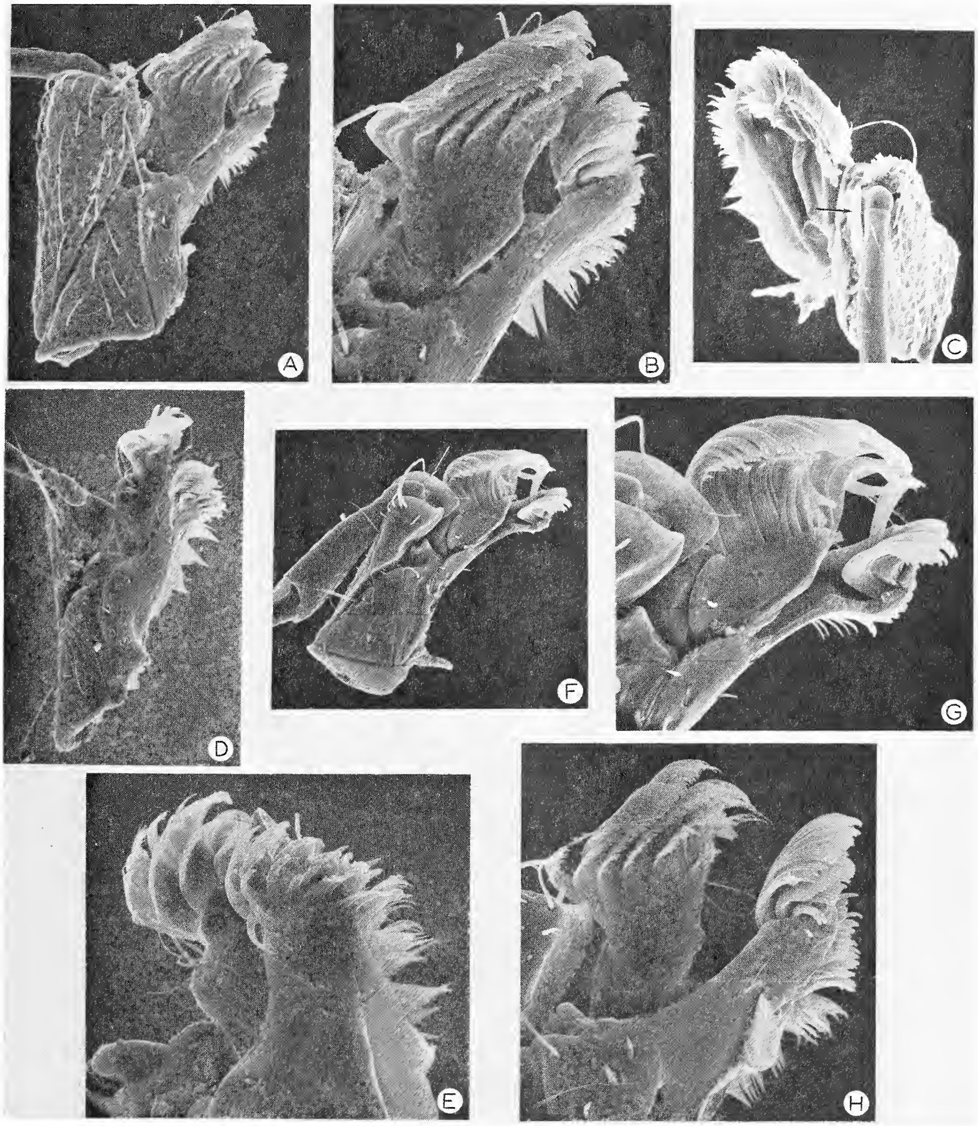
Figs. 151A – D, Tentorium (horizontal arrows indicate foramen in wall separating subesophageal ganglion and muscles of mouthparts; vertical arrows indicate opening through which nerves pass between brain and subesophageal ganglion). (A–B) *Meropathus vectis*. (C) *Parhydraenida reichardti*. (D) *Ochthebius puncticollis*.

morphocline in increasing development from *Ochthebius* and allied genera (*Meropathus*, *Neochthebius*) through *Limnebius*, to *Hydraena* (Figs. 54I,148A-D,152A-F). By out-group comparison, the open condition must be considered primitive, as the coxal cavities are open in the great majority of Hydrophilidae and Staphylinidae. Consequently, direction of the morphocline is presumably toward increased development of the cup-shaped coxal cavity, which again indicates affinities between *Hydraena* and *Limnebius*. The intercoxal process is well developed in *Hydraena* and *Spanglerina* (Figs. 21E,54I, 65D), whereas the proepisternum is markedly reduced in *Limnebius*, both of which I consider derived conditions for these structures.

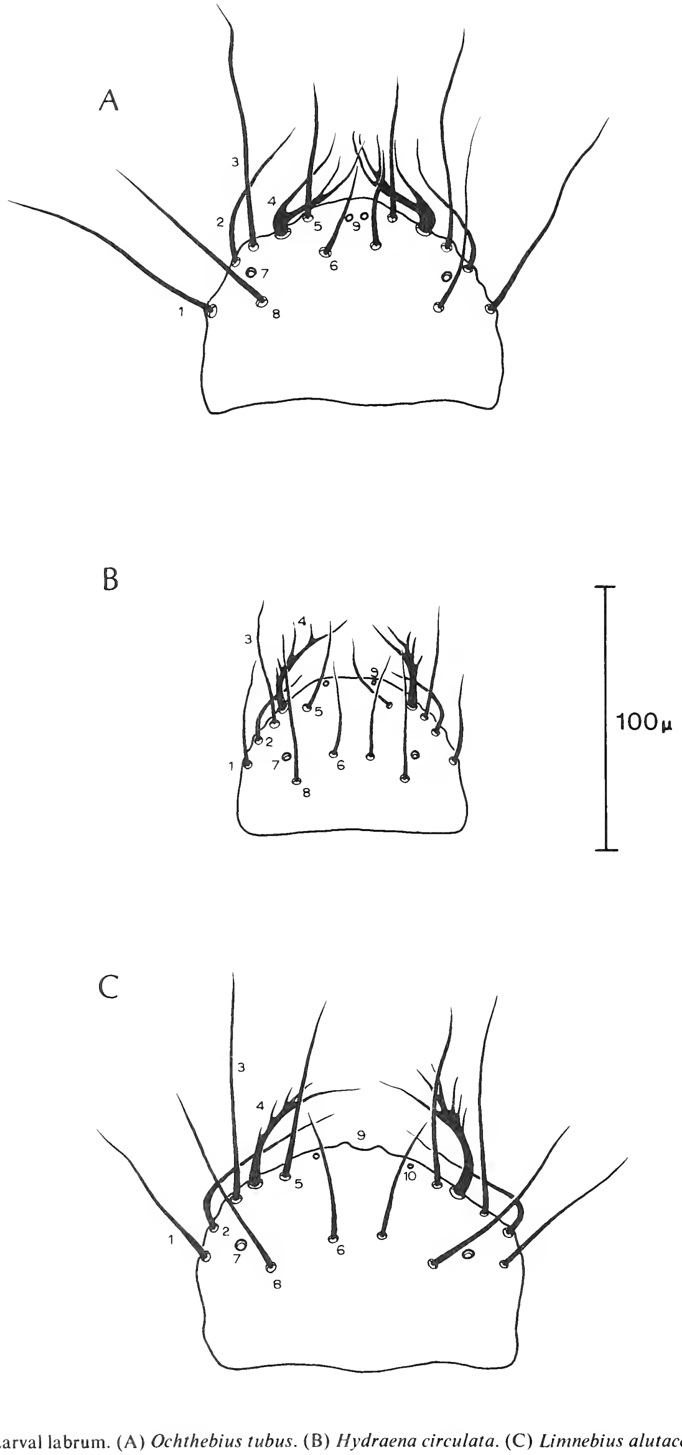
3. Increased values for ratio of maxillary palpus/antenna length in adults.—As discussed earlier, this ratio (P/A) increases from *Ochthebius* to *Hydraena* in this representative sequence: *Ochthebius tubus*, 0.61; *Parhydraenida reichardti*, 0.78; *Limnebius sinuatus*, 1.20;



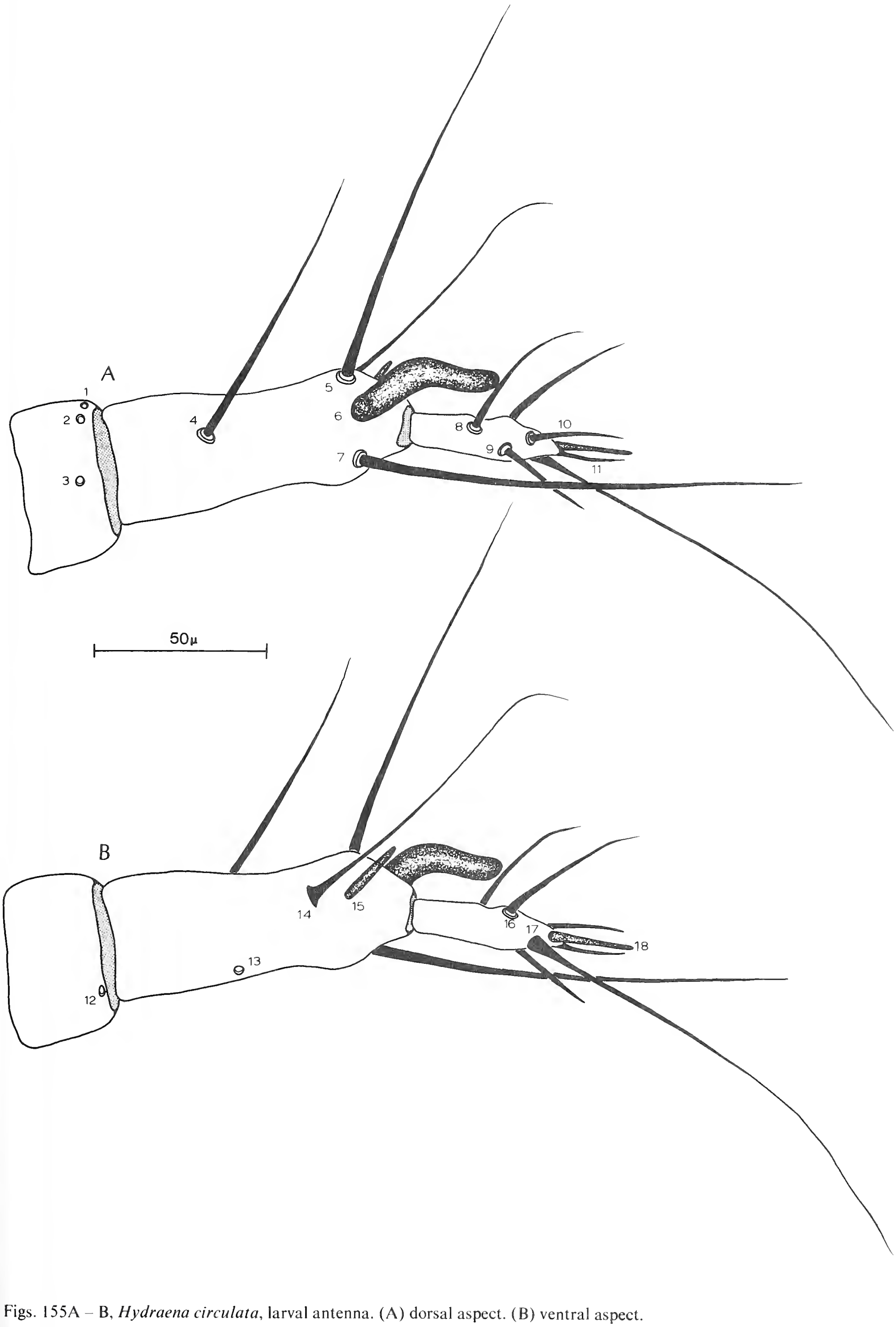
Figs. 152A – F, Prosterna (left leg removed). (A) *Ochthebius tubus*. (B) *Gymnochthebius clandestinus*. (C–D) *Limnebius sinuatus*. (E–F) *Parhydraenida reichardti*.



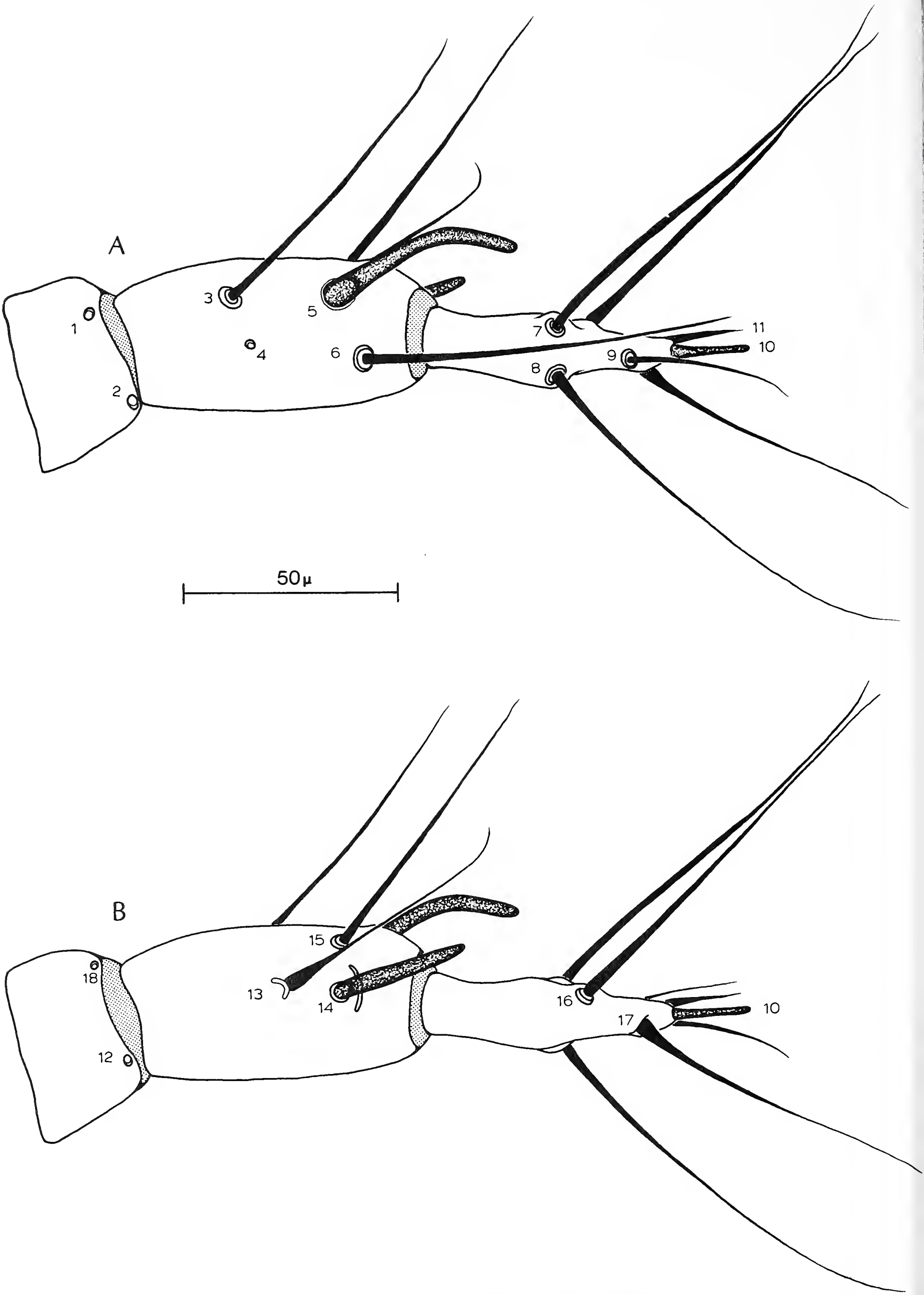
Figs. 153A – H, Adult maxillae. (A–C) *Hydraena atlantica* (arrow indicates "plate" protecting base of palpus). (D–E) *Parhydraenida reichardti*. (F–G) *Limnebius sinuatus* (arrow indicates "plate" protecting base of palpus). (H) *Hydraena anisonycha*.



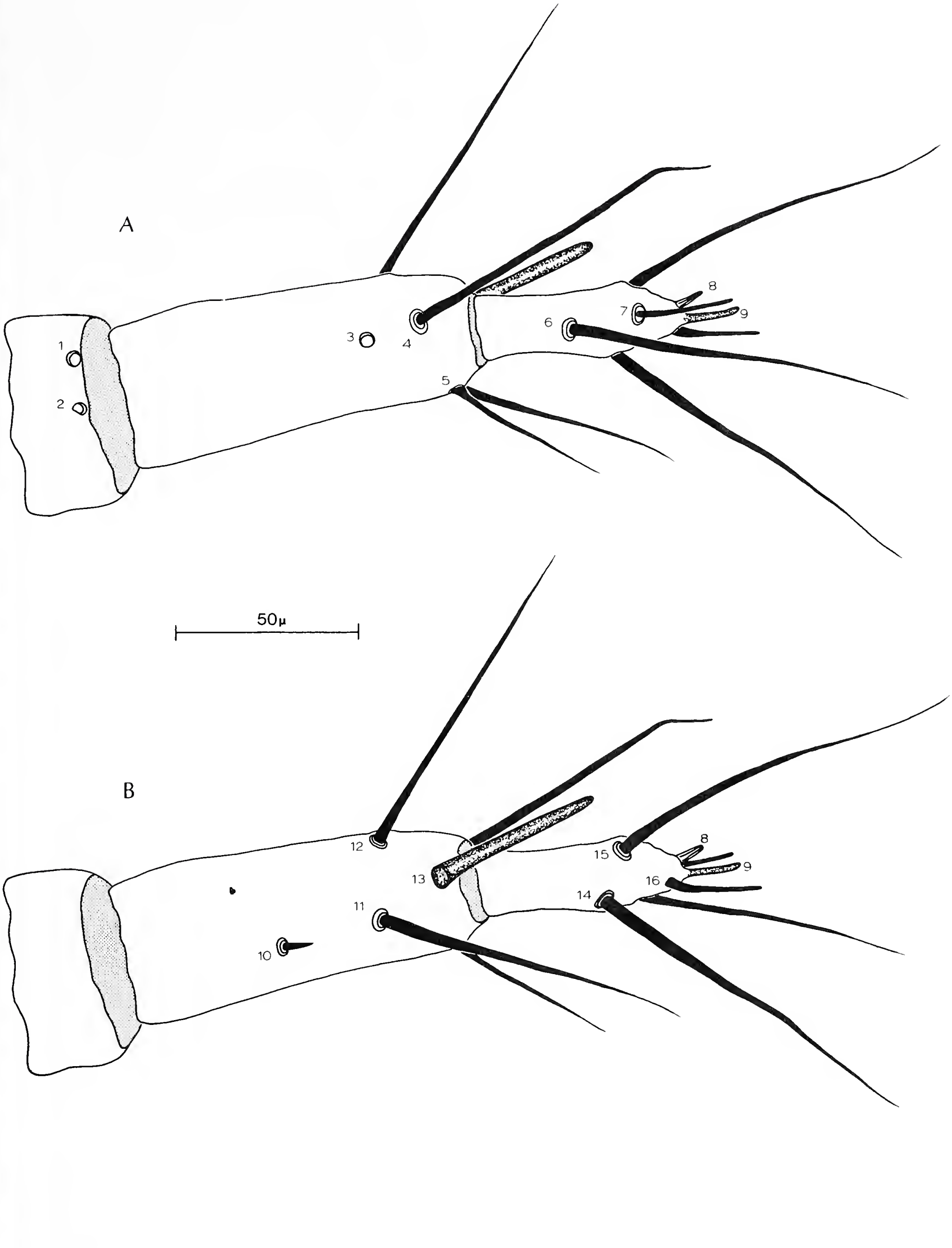
Figs. 154A – C, Larval labrum. (A) *Ochthebius tubus*. (B) *Hydraena circulata*. (C) *Limnebius alutaceus*.



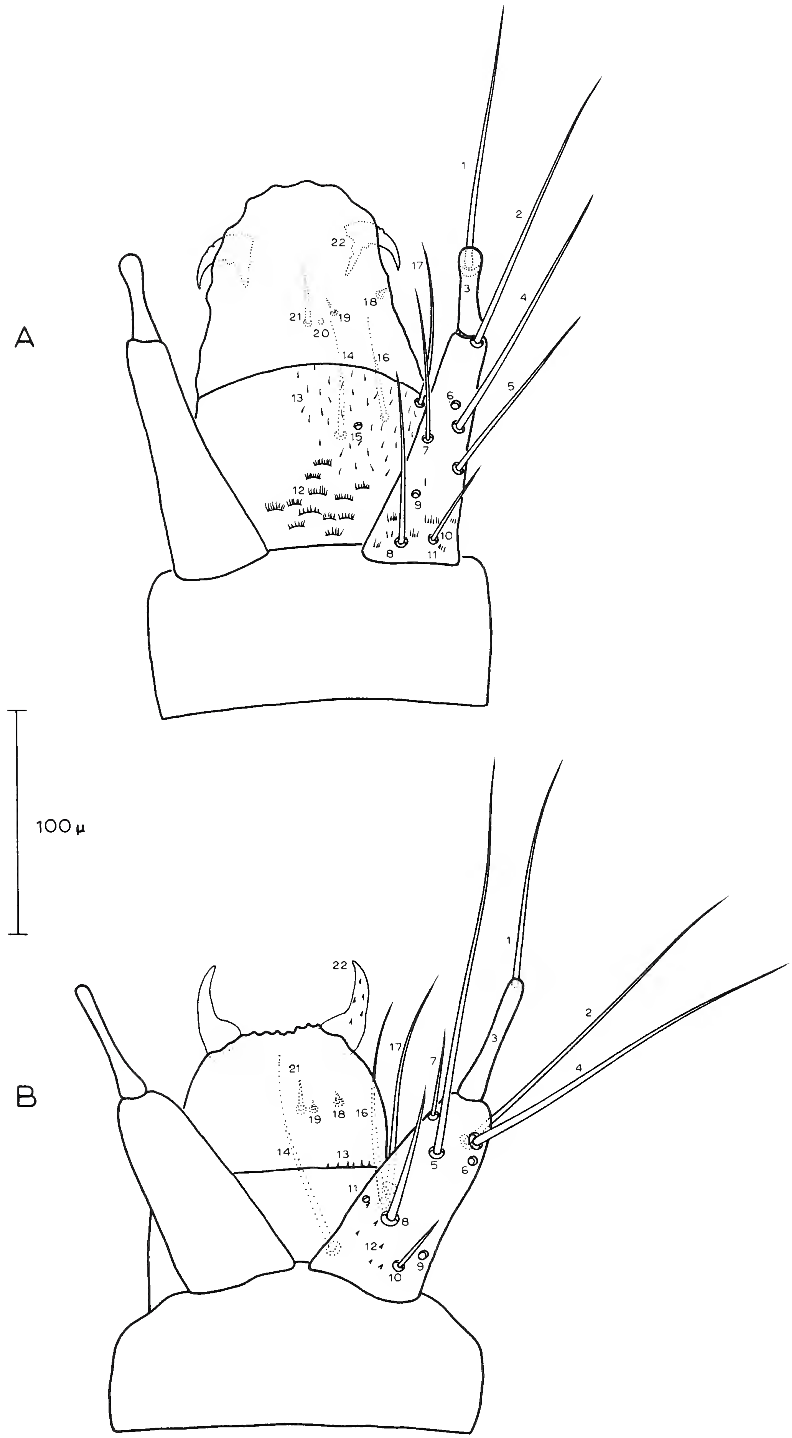
Figs. 155A – B, *Hydraena circulata*, larval antenna. (A) dorsal aspect. (B) ventral aspect.



Figs. 156A – B, *Limnebius alutaceus*, larval antenna. (A) dorsal aspect. (B) ventral aspect.



Figs. 157A – B, *Ochthebius tubus*, larval antenna. (A) dorsal aspect. (B) ventral aspect.



Figs. 158A – B, Apical abdominal segments of larvae. (A) *Hydraena circulata*. (B) *Ochthebius gruwelli*.

Hydraena circulata, 2.00 (Figs. 148A-D). By generalized out-group comparison the plesiotypic state is antenna much longer than maxillary palpus. Thus direction of this morphocline should be toward an increase in value of the ratio (i.e., in the sequence as stated above). The branching sequence suggested by this morphocline, therefore, concurs with that suggested by the two previous morphoclines.

4. *Hydraena–Limnebius* united by antennal sensilla of larvae.— The antennae of *Hydraena* and *Limnebius* larvae (Figs. 155,156) (here represented by *Hydraena circulata* and *Limnebius arenicolus*) have a dorsal and a ventral sensillum, whereas the antennae of *Ochthebius* (Fig. 157) (represented by *Ochthebius tubus*) possess only the ventral sensillum. Richmond (1920) illustrated the antenna of *Hydraena pennsylvanica* with a single sensillum, but two are present (I have used phase-contrast microscopy at a magnification of 1000x). I have also studied other species of *Ochthebius* (these findings and others on hydraenid larvae will be presented in a separate paper devoted solely to larvae) and have found the single sensillum a constant feature in that genus.

By out-group comparison the single sensillum must be considered primitive, as all *Hydrophilidae* (Richmond 1920, and unpublished data) and *Staphylinidae* (*sensu lato*) (Paulian, 1941) have a single sensillum. Consequently, two sensilla is the derived condition, and from which can be inferred monophyly of *Hydraena* and *Limnebius*. Further, shape of the seta adjacent to the ventral sensillum in *Hydraena* and *Limnebius* is also suggestive of a relationship.

Dybas (1976) in his excellent paper on larvae of Ptiliidae and Limulodidae has shown that the antenna of the ptiliid *Nossidium* also has two sensilla whereas the remainder of the ptiliids and limulodids he studied had a single sensillum or a single one which is bifid (*Actidium*). This raises questions concerning which condition is the primitive state since Dybas considers *Nossidium* as the ptiliid genus retaining the most primitive characteristics.

Dybas (1976:41), however, also illustrates the antenna of an undescribed genus near *Nossidium* which lacks the second sensory appendage ("accessory sensory appendage" of Dybas). This undescribed genus is also remarkable in that, according to Dybas, it is the only known ptiliid larva with indications of ocelli or pigmented eyespots, which Dybas considers plesiotypic, "The retention of eye pigment in a member of the most generalized group of Ptiliidae represents a plesiomorphic or ancestral character that has been lost in the other genera studied." That the plesiotypic condition of the ocelli has been retained in this larva certainly does not mean that the antennae necessarily also represent the primitive condition with respect to sensilla, but it does make one suspicious that the two sensilla condition of *Nossidium* may actually be a derived condition, whereas the single sensillum of the remainder of the genera is plesiotypic.

5. *Hydraena–Limnebius* united by form of labral setae in larvae.— The labrum of hydraenid larvae has five pairs of setae along the anterior margin, the second pair from the midline being thickened and branched. In *Ochthebius* these setae (Fig. 154A) bifurcate, whereas in *Hydraena* and *Limnebius* (Figs. 154B,C) the setae are pectinate.

D'Orchymont (1928:8) stated that in the Hydraeninae (*Hydraena* and *Ochthebius*) the "first anterior seta of labrum (on each side) curved to the axis of body and ramous at extremity or at least bifid", whereas in the Limnebiinae (*Limnebius*), the "first anterior seta covered also to the body but single, not even bifid at extremity." In the few larvae I have studied the complex setae are the second pair and these are not simple in *Limnebius*, and suspect higher magnification accounts for differences in our findings.

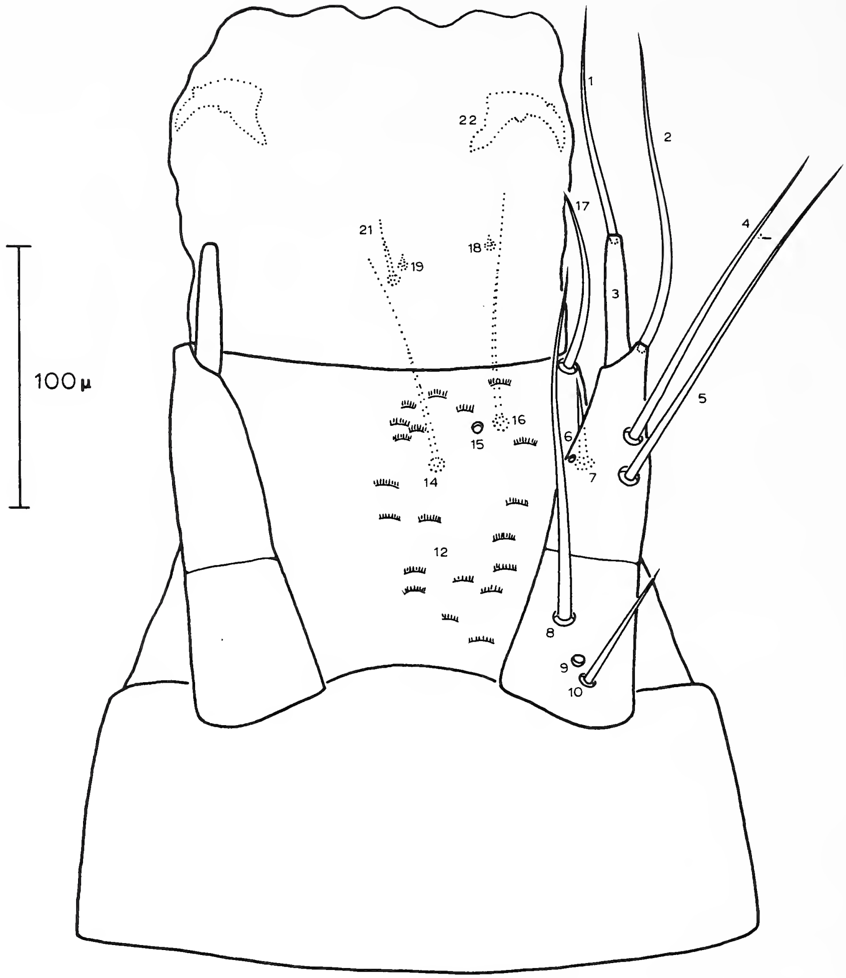


Fig. 159. *Limnebius arenicolus*, apical abdominal segments of larva.

Since I have no means at present for testing whether the pectinate or bifurcate condition represents the apotypic state, the supposed relationship of *Hydraena* and *Limnebius* based upon common possession of the pectinate condition must be considered untested and subjective. Discovery of the larval stage of *Hydraenida*, *Parhydraenida* and other rare genera is necessary to establish morphoclines.

6. *Hydraena–Limnebius* united by form of urogomphi in larvae.— The urogomphi of *Hydraena* and *Limnebius* larvae (Figs. 158A,159) have a seta which originates at the apex of the basal article. *Ochthebius* (Fig. 158B), on the other hand, has this seta originating farther proximally. Moreover, form of the urogomphi in *Hydraena* and *Limnebius* are more similar to one another than either is to *Ochthebius*. Finally, distance separating the urogomphi at their bases, a character often used in keys (Richmond, 1920; d'Orchymont, 1928; Chandler, in Leech

and Chandler, 1956), is equal to or greater than the width of a urogomphus at its base in *Hydraena* and *Limnebius*, whereas in *Ochthebius* the urogomphi are nearly contiguous proximally.

Unfortunately, not enough data are available on urogomphus chaetotaxy or form in the primitive staphyliniform larvae to establish the primitive state, these proposed synapotypies being therefore untestable at this time. Judging from illustrations by Dybas (1976), less derived larvae of Staphylinoidea (i.e., Ptiliidae and Limulodidae) generally have the urogomphi situated dorsally and rather close together. From this one might suspect the ancestral condition of the Staphyliniformia (and the Hydraenidae) to be likewise. Therefore, the more widely separated urogomphi of *Hydraena* and *Limnebius* could be considered synapotypic. Various degrees of urogomphus separation is seen in the more derived Staphylinoidea (Paulian, 1941) and the Hydrophilidae have the apex of the abdomen (in the more derived genera) highly modified to form a stigmatic atrium, whereas the less derived genera (with respect to urogomphi) have the urogomphi moderately separated (*Helophorus*; Richmond, 1920) or widely separated (*Epimetopus*; Rocha, 1967).

7. *Hydraena–Limnebius* united by loss of ocelli from adults.— If ocelli in the adults of Coleoptera represents retention of a primitive condition, then absence of ocelli in *Hydraena* and *Limnebius* could be considered synapotypic and therefore indicative of monophyly. Conversely, common possession of ocelli by *Ochthebius* (plus allied genera) and *Hydraenida* (plus allied genera) cannot be used as indicative of relationships as such a grouping would be based upon symplesiotypy.

8. *Hydraena–Limnebius* united by possession of plate-like structure at base of maxillary palpus in adults.— The maxillae of *Hydraena* and *Limnebius* adults have a thin, plate-like structure arising from the stipes, at the base of the maxillary palpus (Figs. 153C,F). This structure, which presumably adds support to the base of the maxillary palpus, is absent from all other genera studied (*Parhydraenida*, *Ochthebius*, *Meropathus* and *Neochthebius* (but present in *Spanglerina* also). It is presumed that this plate is a derived structure, and therefore indicates monophyly of *Hydraena* and *Limnebius*.

9. Fimbriate galea in adults of *Hydraena* lineage.

10. Stoutly spined lacinia in adults of *Ochthebius* lineage.— Galeae of *Hydraena*, *Limnebius* and *Parhydraenida* adults (Figs. 153A-H) are quite similar, having a well developed, fimbriate apex which is larger and more prominent than the lacinia, and undoubtedly accomplishes most of the gathering of food particles. By contrast, the galea of *Ochthebius*, *Meropathus* and *Neochthebius* (Fig. 98F) is much less complex and does not extend beyond the lacinia, the latter possessing stout scraping processes which obviously perform most of the actual food gathering function of the maxillae.

That two basic types are involved is clearly evident, but which represents the derived state? I propose that the more complex stage of both structures, that is, the complex fimbriate galea of *Hydraena–Limnebius–Parhydraenida* and the stoutly spined lacinia of *Ochthebius–Meropathus–Neochthebius* represent the derived states, the plesiotypic condition being simplified in both structures. Development of the lacinia in one lineage and galea in the other must surely reflect differences in feeding habits, but what these differences may be remain undiscovered. Out-group comparisons, especially in other less derived staphyliniform beetles, are necessary to test these assertions.

11. Non-fimbriate galea in larvae of *Ochthebius* lineage.— Dybas (1976) has shown that larvae of *Hydraena* possess a fimbriate galea and that this structure is common to most genera

in the "leptinid association" of Böving and Craighead (1931). Larvae of *Limnebius* also have a fimbriate galea. However, larvae of *Ochthebius* (Richmond, 1920; unpublished data), *Meropathus* (Paulian, 1941) and *Neochthebius* (unpublished data) lack fringed margins on the galea. If the fimbriate condition is primitive (according to Dybas this would be the primitive state within the "leptinid association", but derived with respect to the Staphylinoidea), then the non-fimbriate condition of *Ochthebius* and related genera can be considered synapotypic.

12. Development of pronotal hyaline borders in adults of the *Ochthebius* lineage.— One of the most distinctive developments of the *Ochthebius* lineage is hyaline borders of the pronotum. These are present at the anterior and posterior margins (*Meropathus*, *Neochthebius*) and generally laterally also (*Ochthebius*, *Gymnochthebius*) (Figs. 80A-F,98A, 145A,C). These transparent borders are probably apotypic as they are lacking from the remainder of the family and also unknown in the Hydrophilidae and (to my knowledge) the remainder of the Staphyliniformia.

13. *Ochthebius–Meropathus–Neochthebius* united by form of the aedeagus.— As discussed in the section on *Gymnochthebius*, the basic plan of the aedeagus in that genus differs from that of other genera of that lineage, i.e., *Ochthebius*, *Meropathus* and *Neochthebius*, and apparently represents a different evolutionary line. Further, it is proposed that the bilaterally symmetrical "median piece" of the aedeagus in the less derived species of *Gymnochthebius* (*G. plesiotypus*, Fig. 82A) more closely approximates the ancestral form of the lineage, and, therefore, the aedeagal type of *Ochthebius–Meropathus–Neochthebius* which possesses a terminal mobile piece (and lacks the internal tube seen in *Gymnochthebius*) represents a derived state.

14. *Neochthebius–Meropathus* united by fused elytra, body form, metasternal shape, and habitat.— As discussed in the sections on *Neochthebius* and *Meropathus*, the above similarities suggest monophyly of these two genera. No doubt the character states are apotypic.

15. *Hydraenida–Parhydraenida–Coelometopon* united by form of head, number of antennomeres , form of metasternum, and habitat.— Similarity of *Hydraenida* and *Parhydraenida* adults in external features are apparent (refer to the section of *Parhydraenida*). They share with *Coelometopon*, a very highly derived madicolous genus from east Africa, 11 antennomeres which are in well developed grooves beneath the eyes (Fig. 16A). Additionally, the metasternum of these three genera has a longitudinal impression in the midline and the maxillary palpi are of similar proportions.

16. *Hydraena–Spanglerina* united by elongate maxillary palpi of adults.— No doubt the elongate maxillary palpi of these two genera (Fig. 148D) represent an apotypic character state.

17. *Limnebius–Laeliaena* united by smooth body form.— The reduced body form of adults of these two genera is readily apparent and derived. *Laeliaena*, a rare genus from Turkestan (1 species) and India (1 species), retains the incised posterior angles of the pronotum (a primitive condition) but is very similar to *Limnebius* in other characters. (Note: my concept of *Laeliaena* is based on specimens of *Laeliaena sahlbergi* Champion in the BMNH; I have not seen adults representing the type of the genus, *Laeliaena sparsa* Sahlberg).

Two primary evolutionary lines are inferred from morphological data (see phylogram, Fig. 147); *Ochthebius* plus related genera, and the *Hydraenida–Hydraena–Limnebius* lineage. Consequently, I propose that the *Ochthebius* group be recognized as a new subfamily, the Ochthebiinae, and that the Limnebiinae (of authors) be ranked as a subtribe within the Hydraeninae. Further, to reflect differences in the two major lineages within the Hydraeninae, I propose that they be recognized as tribes, the Hydraenini and Hydraenidini. Within the

Hydraenini two new subtribes are proposed, Hydraenina and Limnebiina.

Zoogeography at the Generic Level

The nine genera of Hydraenidae now recognized in the Western Hemisphere display rather distinct Gondwanian or Laurasian distribution patterns, indicating that most, if not all of the genera evolved before North and South America separated from their respective supercontinents. To the contrary, however, several species groups within the genera appear to be endemic to the Western Hemisphere and therefore possibly originating after splitting of the continents.

The Gondwanian components include *Gymnochthebius*, *Hydraenida*, *Pahydraenida*, *Meropathus* and the *leechi* and *marginicollis* Groups of *Hydraena*, whereas the genera *Ochthebius* (including both subgenera) and *Limnebius*, and apparently also the *circulata* Group of *Hydraena*, are of Laurasian origin (Figs. 160,161). *Spanglerina* might be endemic to Central America, but I would not be greatly surprised if it is eventually found in Africa.

Genus *Gymnochthebius*

Gymnochthebius has a wide distribution in South and Central America, with few species in North America (Fig. 161). It is also represented in Australia (d'Orchymont, 1943; Janssens, 1967a), but is apparently absent from Africa. This distribution pattern is consistent with current hypotheses regarding separation sequence of Africa, South America, Australia and New Zealand (Keast, 1973), in which Africa is postulated as the first component to have separated from the Gondwana landmass.

As discussed more fully in the classification section, the less derived lineages (i.e., *plesiotypus* lineage) are in southern South America (Chile and Argentina), whereas the more derived lineages (*laevipennis* and *oppositus* lineages) are North American. Absence of these derived groups from the Palearctic indicates that these lineages possibly evolved after continental splitting (see later sections on these groups for phylogenetic relationships). The *nitidus* Subgroup might also be in this category, but the wide distribution of one of its species (*G. fossatus*) in South America invites the suspicion that the Subgroup might also be in Australia (the Australian fauna is too incompletely known to confidently use *absence* of a lineage as evidence for post-split evolution).

Genus *Hydraenida*

Hydraenida and the closely related *Parhydraenida* are currently known only from South America (Fig. 160). However, I have seen an undescribed species of *Hydraenida* from South Africa and suspect that *Parhydraenida* will eventually be found there also. These data appear to contradict what was stated previously regarding earlier separation of Africa, but absence of these two genera from Australia may only be apparent. If distribution of *Hydraenida* is correct, then one must surmise that the genus was present in the South American and African, but not Australian, components of Gondwana before continental split.

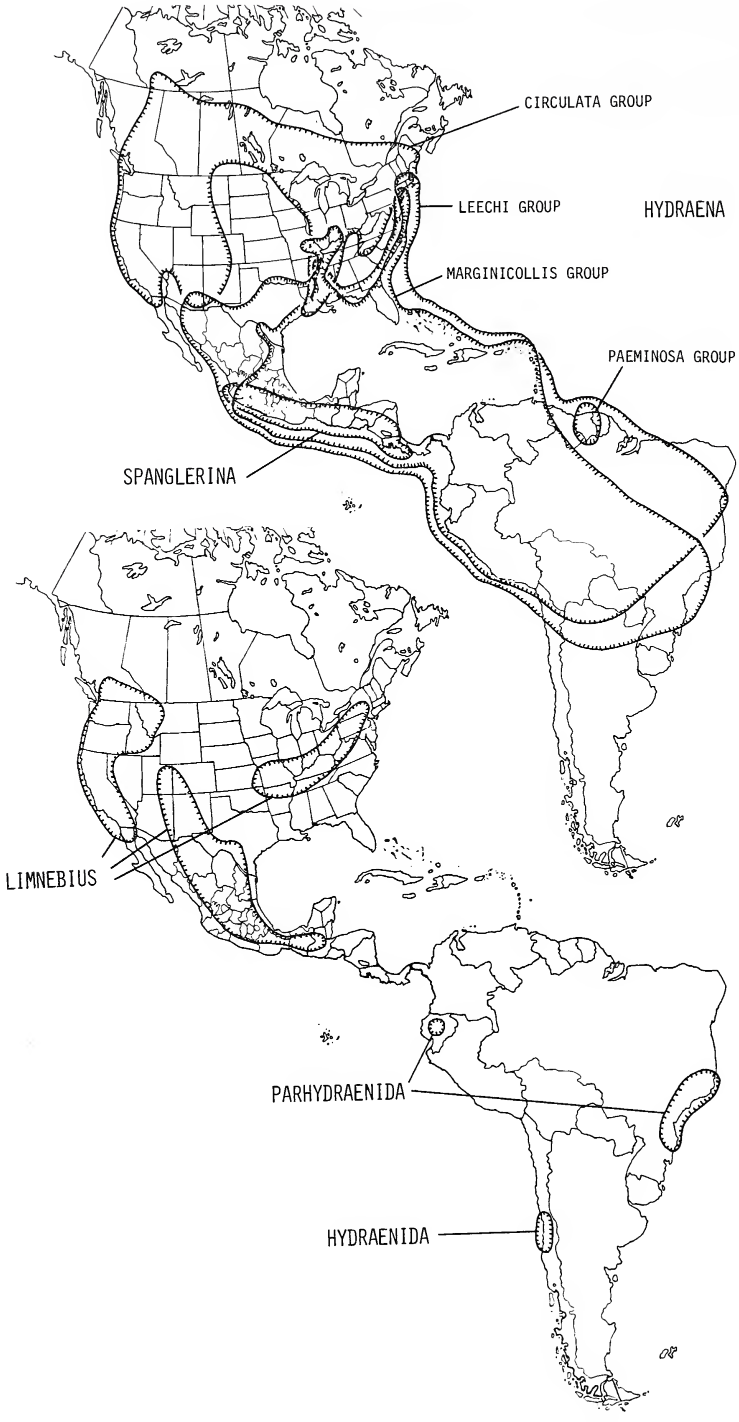


Fig. 160. Generalized geographical distributions of hydraenid genera *Hydraenida*, *Parhydraenida*, *Hydraena*, *Spanglerina* and *Limnebius* in the Western Hemisphere.

Fig. 161. Generalized geographical distributions of hydraenid genera *Gymnochthebius*, *Ochthebius*, *Neochthebius* and *Meropathus* in the Western Hemisphere.

Genus *Parhydraenida*

Parhydraenida is restricted almost entirely to the mountains of southeastern Brazil, with one widely disjunct species, *P. pentatenkta*, in Ecuador (also an undescribed species in Paraguay). This disjunct distribution may be simply a result of insufficient collecting in intervening areas.

Based upon label data, *Parhydraenida* is clearly hygropetric, as is the related *Coelometopon* from Tanzania (see Janssens, 1972b). *Hydraenida* apparently is not strictly hygropetric, as Paul Spangler has collected *H. robusta* from small pools at a roadside seepage area of loess substratum.

Genus *Meropathus*

Meropathus has a typical austral Gondwanian distribution pattern, living on islands of the New Zealand subregion (3 species), the island group consisting of Prince Edward Islands, Kerguelen Island and Heard Island (1 species), eastern Australia (3 species), and Isla de los Estados and Falkland Islands at the tip of South America (1 species), the latter discovery completing the circum-polar distribution pattern.

As Ordish (1971) has noted, the early supposition that *Meropathus* was endemic to the subantarctic islands was dispelled by discovery of Australian species, and suggests that their present distribution may be a result of continental drift. Since insular species are frequently taken from nests of large oceanic birds, together with the fact that these beetles have relatively long, stiff bristles on the dorsal surface which collect debris, possibly these beetles could adhere to feathers of birds and thus be dispersed to other islands.

But if one proposes that individuals of the *vectis–campbellensis* stem species were brought by birds from Campbell Island to South America (ca. 4,800 miles), does not this suggest that transport of these beetles over short distances must be a much more common occurence? If this be so, then one would suspect transport between Campbell Island, Auckland Islands and Snare Islands (ca. 200 miles between each) is frequent enough to result in dispersal, not speciation. This clearly is not so; each island group has a different species (see Ordish, 1971), and no two species are found on one island. Distribution of the Australian species must be explained by methods other than avian transport as they are associated with streamside habitats, not nests of large oceanic birds.

Genus *Hydraena*

Hydraena (Fig. 160) includes four groups, two of which (*leechi* and *marginicollis* Groups) are widespread and principally tropical, which have invaded North America via the Mississippi River drainage system and the eastern coastal regions. These two groups, as now known, do not extend into the more temperate areas of southern Argentina and Chile (this may be a collecting artifact with regard to Argentina, but the large number of *Gymnochthebius* specimens I have seen from Chile suggests that appropriate collecting has been done in that region, although no *Hydraena* has been found). Another component (*circulata* Group) is strictly North American,

forming small areas of sympatry with the tropical groups in southern Arizona, the Mississippi drainage, and in northeastern United States. The last of the four components (*paeminosa* Group) is known only from a single species in Surinam.

I have seen specimens of *Hydraena* from the Palearctic, Ethiopian and Australian regions which appear to be members of the *leechi* Group, and also suspect that the *marginicollis* Group was rather widespread on Gondwana and, to a less extent, Laurasia, before the New World diverged. Within these two lineages, however, are several sublineages with apotypic states not yet described in Old World forms (i.e., scintilla of the pronotum) suggesting that at least the *leechi, alternata* and *scintillabella* Subgroups of the *leechi* Group evolved after continental separation. I also suspect that the more highly derived sublineages within the *marginicollis* Group (i.e. *anisonycha* Complex of the *marginicollis* Subgroup and the *geminya* Subgroup) evolved following continental splitting. The amount of taxonomic work remaining to be done on Old World members of this large and complex genus, especially in tropical areas, prevents a definitive statement at this time.

The *paeminosa* Group, with its single species in Surinam, has important external characteristics in common with the Nearctic *circulata* Group, but has a much different (more highly derived) aedeagus in which the parameres are reduced to small processes near the apex (Fig. 95D)(a condition convergent with *Parhydraenida*). It may be a remnant of the North African component of the principally Laurasian *paeminosa–circulata* stem group.

Minimum age of *Hydraena* in North America can be inferred from fossil fragments of the extant species, *H. angulicollis* from Pleistocene deposits of Scarborough Bluffs, near Toronto, Ontario. These fragments are reputedly 70,000 years old (see Morgan, 1971)(see comments below concerning *Ochthebius* fossils).

Genus *Ochthebius*

Ochthebius is clearly of Laurasian origin, both subgenera in the Western Hemisphere being well represented in the Palearctic. In fact, at least two of the four sublineages (*interruptus* and *benefossus* Groups) have Palearctic components. The other two sublineages (*bisinuatus* and *biincisus* Groups) apparently have evolved after continental separation (or were present before the split but only in the pre-North American component).

The great concentration of different lineages and species in western North America as opposed to the two species (*O. benefossus* and *O. putnamensis*) in eastern North America (see Figs. 180-185) might be cited as evidence in support of the "Pacifica" theory in which land components of western North America are theorized to be of a western Pacific (eastern Palearctic) origin.

This western North American distribution might also be credited to Pleistocene dispersal of stem species across the Bering land bridge (see Darlington, 1957). The holarctic distribution of *O. kaszabi* and *O. marinus*, plus the usual habitat of those species, boreal ponds, suggests such a dispersal. The majority of other species in the genus in western North America, however, are montane stream forms, a habitat not generally associated with the land bridge. A possible scenario is that a stem species of all *Ochthebius* (*sensu stricto*) in the New World (or several stem species, each the ancestor of its respective sublineage of *Ochthebius (sensu stricto)*) crossed the land bridge, diverged and proliferated to form the *Ochthebius* seen today, two species of which, *O. kaszabi* and *O. marinus*, later recrossing into the Palearctic.

However, through the courtesy of Dr. Anne Morgan I have seen a fossil pronotum which is either *O. kaszabi* or *O. marinus* (it is impossible to be totally certain because of morphological overlap of pronotal characters in present day specimens). This beetle fragment is from Pleistocene deposits near Toronto, Ontario which are dated at about 100,000 years of age (Morgan, in litt.). We know, therefore, that *O. kaszabi* or *O. marinus* had already evolved before the Pleistocene (if one assumes that its presence in both the Nearctic and Palearctic is due to crossing the land bridge, then it must have been present before emergence of the bridge; of course, this is true also if the present distribution is due to a Laurasian pattern).

The aedeagus of *O. kaszabi* is strikingly different from aedeagi of New World species with which it is most closely related (i.e., *O. marinus*, *O. borealis* and *O. uniformis* -Figs. 108A-D,110A-D). This prompts the inference that its presence in the New World is due to relatively recent (Pleistocene) dispersal across the Bering land bridge. Its sister-species, therefore, possibly exists in the Palearctic, and is not one of the Nearactic members of its lineage. In fact, the Palearctic and Nearctic populations of *O. kaszabi* at present are genetically and morphologically diverging due, in part, to range disjunction of the ancestral stock, caused by the Bering Sea.

Fossil fragments (pronotum and elytra) of *O. (Asiobates) discretus* from the Pleistocene Scarborough Bluffs deposits near Toronto, Ontario, which are 70,000 years old (see Morgan, 1971) leads to the inference that the subgenus *Asiobates* was probably also present in North America before Pleistocene glaciation.

Genus *Limnebius*

Limnebius occupies, in North America, three slightly disjunct areas (Fig.160), the Great Basin and Central Prairies lacking proper habitats for this genus. It extends southward as far as Guatemala, but is unknown from the remainder of Central America, the Antilles and South America. The genus is best represented in north temperate areas, apparently being Laurasian in origin as it is absent from South America and Australia. Its presence in Africa, therefore, is probably a product of range expansion after South America and Africa separated. Its presence in North America is probably a result of Laurasian distribution, not recent dispersal.

Genus *Neochthebius*

The genus *Neochthebius* is currently known only from two closely related intertidal species, *N. granulosus* from Japan and *N. vandykei* of the North American Pacific coast (Fig. 161). *Neochthebius* is apparently the sister-group (see previous section on phylogeny) and Laurasian counterpart of the Gondwanian *Meropathus*. The distribution of *Neochthebius* in Japan and western North America (instead of South America or Africa) suggests that the stock from which the two genera are derived probably was present at the "Australian end" of Pangaea. The presence of *N. vandykei* on the opposite side of the Pacific Ocean from Japan may be explained by dispersal in sea currents along the coast (they are wingless) in Pleistocene times (and subsequent vicariance), or by referral to a "Pacifica" land movement model.

Zoogeography and Phylogeny within the Genera

Vicariance and Chance Survivors Models.— The number of new taxa described herein is an indirect indication of the work remaining to be done in other regions of the world, especially Africa and Australia; considerations of historical zoogeography and phylogeny of the family should be tempered by this reality. Even within South America I suspect knowledge of the hydraenid fauna is quite incomplete, at least in respect to species diversity within *Gymnochthebius* and, especially, *Hydraena.*

My level of confidence is high, however, that distributional limits now known for *Limnebius* (not found south of Guatemala) and *Ochthebius* (southern limits in northern South America for stream species - halophilic species such as *O. attritus* extending farther southward along the coasts) approximate the real limits (Figs. 160,161).

Even within Central America and the Caribbean Islands knowledge of the hydraenid fauna is incomplete, at least for *Hydraena.* The groups of species now known, based primarily upon aedeagal structure, such as the *particeps* Subgroup and the *mexicana* and *marginicollis* Complexes (see below), suggest that our knowledge of *Hydraena* in that region is sufficiently complete to permit a reasonable evaluation of the relationships of structural evolution and historical zoogeography.

The North American fauna is the most completely known, which distinctly enhances discussion of species of that region which have affinities with primarily tropical components of the hydraenid fauna.

At the time of this writing there has been, within the pages of the journal *Systematic Zoology*, much discussion and disagreement concerning two theories which attempt to explain patterns of plant and animal distribution: 1) center of origin and dispersal, and 2) vicariance.

Croizat, Nelson and Rosen (1974) summarize the differences between these two theories and I refer the reader to that paper and its bibliography for anterior works related to the topic. Briefly, both theories accept dispersal of organisms and that genetic isolation of a populational (species) subunit is necessary for speciation to occur. They differ in their suppositions regarding temporal relationship of dispersal and barrier formation.

Because both theories accept occurrence of dispersal, it is inappropriate to refer to one theory as "center of origin and dispersal" (and to its advocates as "dispersalists"). I propose to designate this theory as that of "chance survival" for reasons presented below.

Proponents of vicariance reject the idea that the primary driving force in speciation is chance dispersal of a few individuals across a *nearly perfect, pre-existing barrier*(my emphasis) (topographic, ecologic, etc.), and the supposed isolation that follows which would provide the time necessary for genetic divergence and eventually speciation. Instead, vicariance advocates propose that barriers arise *within* distributional limits of a species, dividing it into two or more isolated populations which then undergo genetic divergence, eventually to the level of species (see Platnick, 1976).

Since advocates of vicariance acknowledge dispersal, they must accept that crossing nearly perfect, pre-existing barriers does occur, but their denial of this process as a *major* cause of speciation presupposes that the rate of genetic divergence between the two populations thus formed is slow enough that subsequent, and repeated crossings of the nearly perfect, pre-existing barrier will occur before, and prevent, speciation; and/or that occurrence of nearly perfect pre-existing barriers is rare in nature.

It appears that a perfect balance of three factors must be reached for speciation to occur when "chance survivors" cross a pre-existing barrier. First, rate of genetic change must be

adequate to allow speciation to take place before the next "chance survivors" arrive (if individuals cross a static barrier once, logic dictates that, given enough time, other individuals will also cross).

Second, balance between vagility of species and effectiveness of the barrier must be within very narrow limits. By way of example, if a stream-dwelling hydraenid species is expanding its range and encounters an arid, streamless barrier, for the "chance survivors" theory to operate, vagility of the species and size of the arid barrier must be perfectly matched. If the barrier is too extensive for the vagility of that particular species, no crossing will be achieved; conversely, if vagility is too great for that particular barrier, too many crossings will be accomplished and consequently range expansion will occur and not speciation.

Further, the slower the rate of genetic divergence, the greater the length of time necessary for speciation of two reproductively isolated populations; hence, the slower this rate the more "perfect" must be the match between vagility and the barrier.

Therefore, advocates of the importance of chance survival postulate perfect balance between these three components: 1) dispersal capabilities (vagility), 2) barrier completeness, and 3) genetic divergence.

By contrast, advocates of the importance of vicariance postulate that 1) totally effective barriers arise within the distributional limits of a species, and 2) duration of a barrier is adequate to permit genetic divergence necessary for speciation. A perfect "mix" of the vagility-barrier-genetic divergence components of speciation is not necessary for the vicariance model. Based upon the great number of extant and extinct species, the vicariance model must also postulate occurrence of numerous range interruptions to account for the great diversity of plants and animals. (Existence of numerous barriers is also implied in the chance survivors model; in fact, many more than the vicariance model since only a small percentage of those barriers would be sufficiently perfect to permit speciation). This supposition certainly is not inconsistent with our current knowledge of plate tectonics, continental drift, orogeny, climatic shifts, etc..

Because of 1) the narrow constraints imposed by the chance survivors model, 2) knowledge of continental drift and other events that lead to vicariance, and 3) relatively slow genetic divergence (as opposed to dipersal capabilities of winged insects) indicated by age of fossil beetle fragments of extant species (see Coope 1967; Coope and Brophy, 1972; Ashworth and Brophy, 1972; Ashworth 1973a,b; Morgan 1972), I find the vicariance model the more logically attractive of the two concepts, and therefore interpret distribution data with vicariance in mind (although not disregarding the chance survivors model).

Genus *Hydraenida*

Marked dissimilarity in male genitalia (Figs. 13A,B) suggests that the two included species diverged from a common ancestor a long time ago.

Genus *Parhydraenida*

The provisional phylogeny (Fig. 162) is based upon the following postulated synapotypies (numbers refer to those given in phylogram): 1) hydrofuge pubescence of abdominal sterna 1-4

plus anterior portion of 5; 2) hydrofuge pubescence on abdominal sterna 1-2 plus anterior portion of 3; 3) aedeagus with well developed dorsal lobe (e.g., largest lobe in *reichardti*, Fig. 18A); 4) reduced pronotal sculpture; 5) aedeagus with a lobe between flagellum and median piece (Fig. 18B); 6) clypeus quadrate, aedeagus with dorsal lobe partially or wholly coalesced (Figs.18C,19); 7) right paramere reduced to spike situated at apex of median piece; 8) aedeagus with short left paramere.

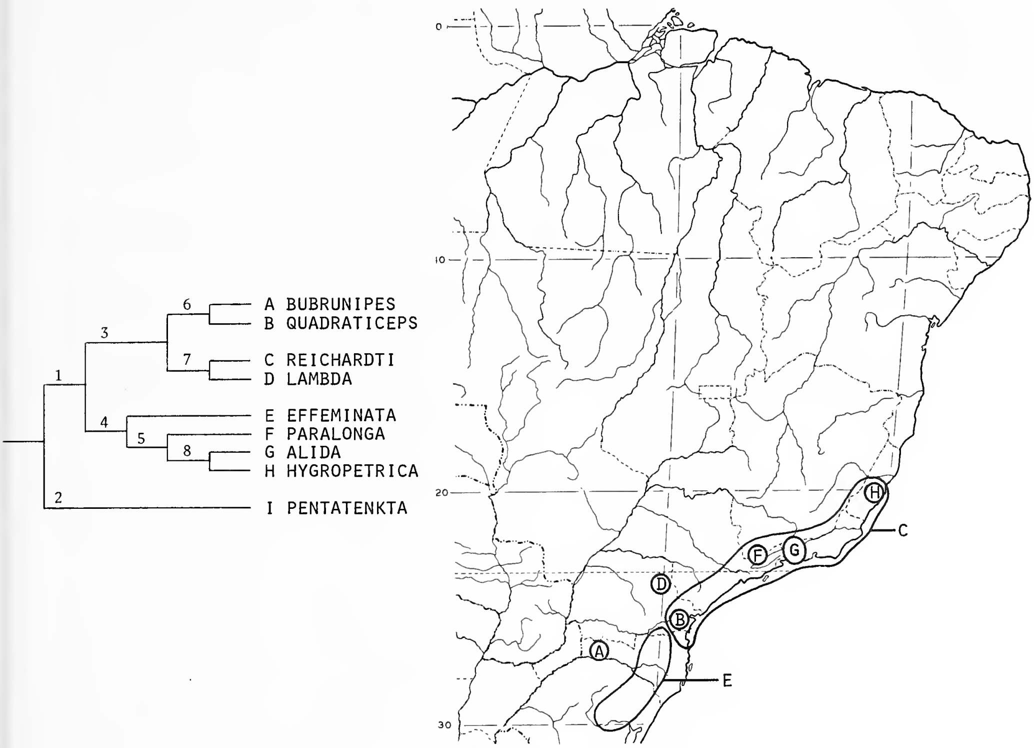


Fig. 162. Generalized geographical distributions and proposed phylogeny of *Parhydraenida* species in southeastern Brazil (*P. pentatenkta*, an Ecuadorian species, is omitted).

Validity of this proposed phylogeny will be tested when the male of *P. pentatenkta* is discovered and its aedeagus characterized. Further, I have seen a number of females from southeastern Brazil which apparently represent additional undescribed species. Once the males of these species are described and their aedeagi characterized, relationships suggested herein can be further tested and the reconstructed phylogeny modified accordingly.

Comparison of the phylogeny and distribution patterns suggests a vicariant event between current distributions of *P. bubrunipes* and *P. quadraticeps*. This event could have concurrently split the stem species of those two species and also provided the first dichotomy in the other major lineage (i.e., *P. effeminata* to the south, and its sister-group to the north). The distributions at first glance appear sympatric, but this is due to the rather widely distributed *P. reichardti*. Actually, no proposed sister-species pairs display sympatry. Whether this reflects actual distributions or is an indication of inadequate sampling remains to be seen.

Genus *Hydraena*

The species of *Hydraena* in the Western Hemisphere are arrayed in four major lineages. The proposed phylogenetic relationships of these four lineages are based upon complex aedeagal structure and development of a pronotal scintilla in the *leechi* and *marginicollis* Groups (Fig. 163A:1) and the development of a genal ridge and concave intercoxal sternite in the *circulata* and *paeminosa* Groups (2). Plesiotypic states of these characters include: a simple aedeagus, lack of a pronotal scintilla, lack of a genal ridge, and a flat intercoxal sternite. This provisional phylogeny will be verified or modified as the phylogeny of non-Western Hemisphere species of *Hydraena* are elucidated. At present, I suspect that each of these four groups were well defined before continental drift, as a preliminary study of species from the Ethiopian and Australian regions indicates close similarity with members of the *leechi* and *marginicollis* Groups.

Adults of the *circulata* Group share marked similarities in habitus and aedeagal details which are taken as evidence for monophyly. The pronotum of *H. paeminosa*, the only species now known for the *paeminosa* Group, bears a resemblance to that of the *circulata* Group; likewise, the intercoxal sternite is shaped similarly in both Groups. *H. paeminosa* differs in that the elytral punctures are totally random, not in series as in *circulata* Group species. Additionally, aedeagi of *H. paeminosa* males differ in basic plan from those of males of the *circulata* Group, having the parameres very reduced, originating near the apex of the aedeagus. *H. paeminosa* is a South American species; all *circulata* Group species are Nearctic.

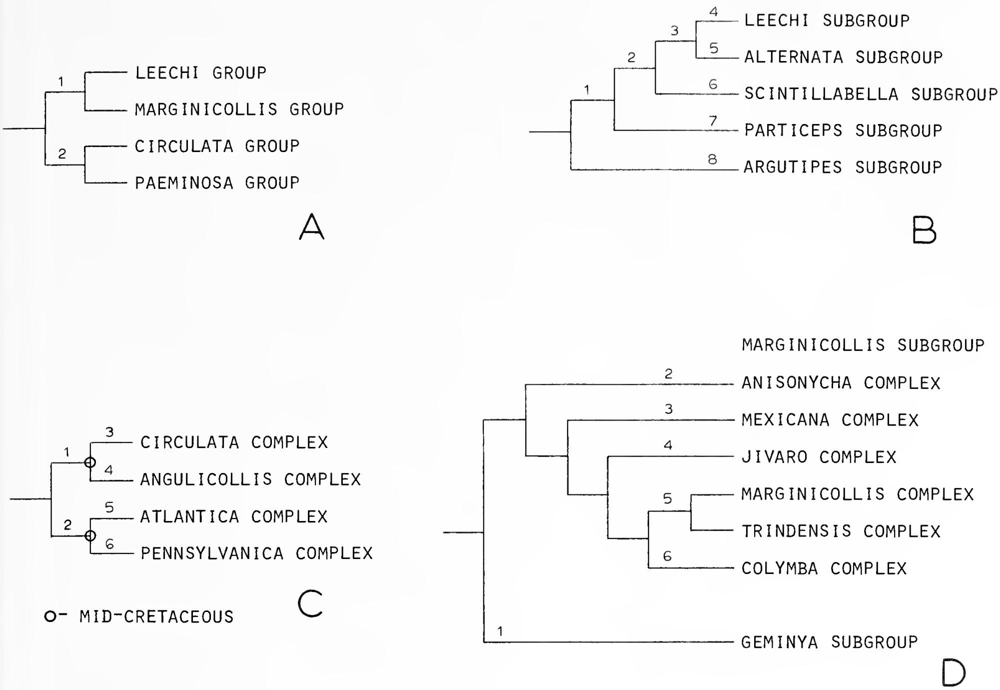
Members of the *leechi* Group have depressions on the pronotum (posterointernal foveolae), whereas *marginicollis* Group members lack these foveolae. This may seem a rather insignificant distinction, however, aedeagal structure in the two groups more-or-less corroborates the dichotomy.

Inferring phylogenies of many of the sublineages of *Hydraena* is complicated by the existence of "clusters" of species, the members of which can reliably be distinguished from one another only on the basis of aedeagal structure. These "clusters" occur in every major lineage and, since they lack external derived character states (observable, at any rate), greatly hinder an already difficult task. With this in mind, the reader should view the following phylogenies as very preliminary steps in determining relationships, and as "road maps" for further study.

The *circulata* Group.

This group contains several species whose members cannot be reliably distinguished externally. For the most part, the group displays "clusters" of similarly shaped aedeagi which, it seems logical to assume, are indicative of phylogenetic relationships. Within these "clusters" however, variation of form is such that morphoclines are not readily apparent, and phylogenetic inference is of necessity highly speculative. Nevertheless, I feel the genitalic data are acceptable for reconstruction of a phylogeny.

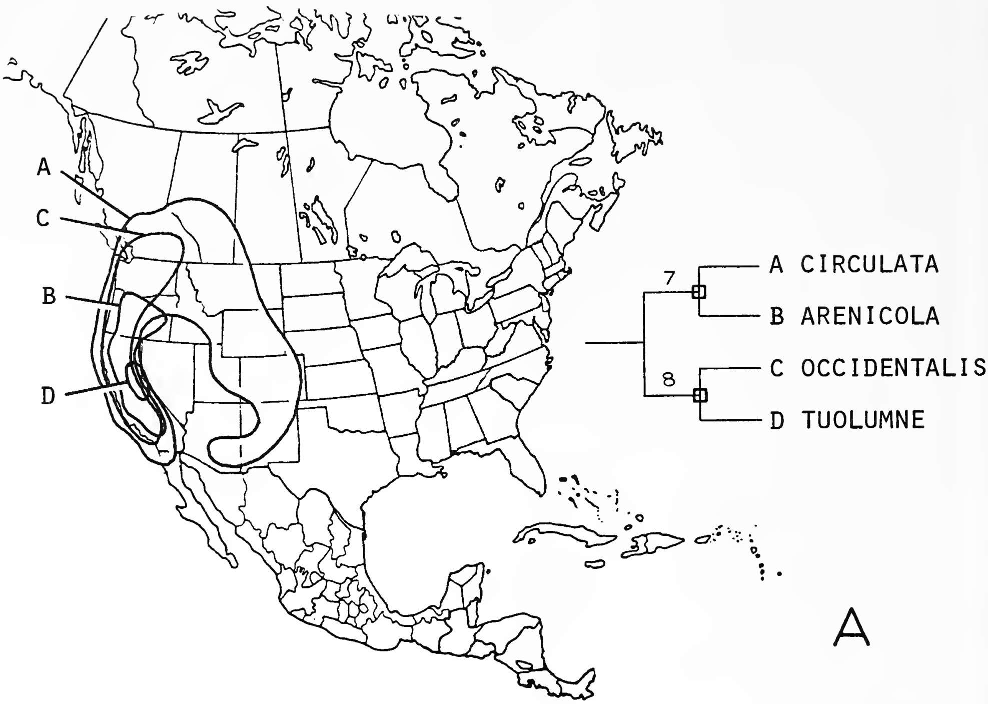
I have arranged the species of the *circulata* Group in four complexes based upon similarities in the aedeagus (Figs. 163C,164A,B,165A,B) (numbers given in parentheses below refer to those given in the phylograms). Males of *Hydraena circulata* (3) and those of the three other species in its complex (Fig. 164A) have the transparent lobe at the apex of the aedeagus rather well developed in relation to the size of the apical filament which arises from the lobe; additionally, these species have long and dense setae on the parameres (Figs. 22A-E). Males of *Hydraena angulicollis* (4) and those of the two other species in its complex (Fig. 164B) have

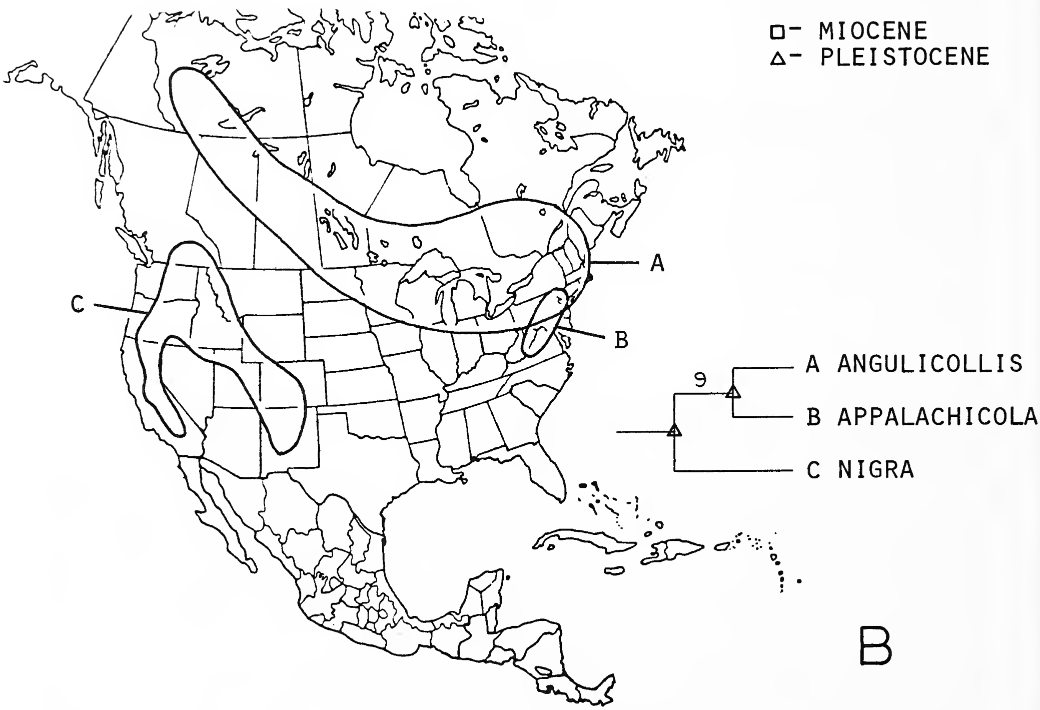


Figs. 163A – D, Proposed phylogeny of major sublineages of *Hydraena*. (A) group relationships. (B) *leechi* Group. (C) *circulata* Group. (D) *marginicollis* Group.

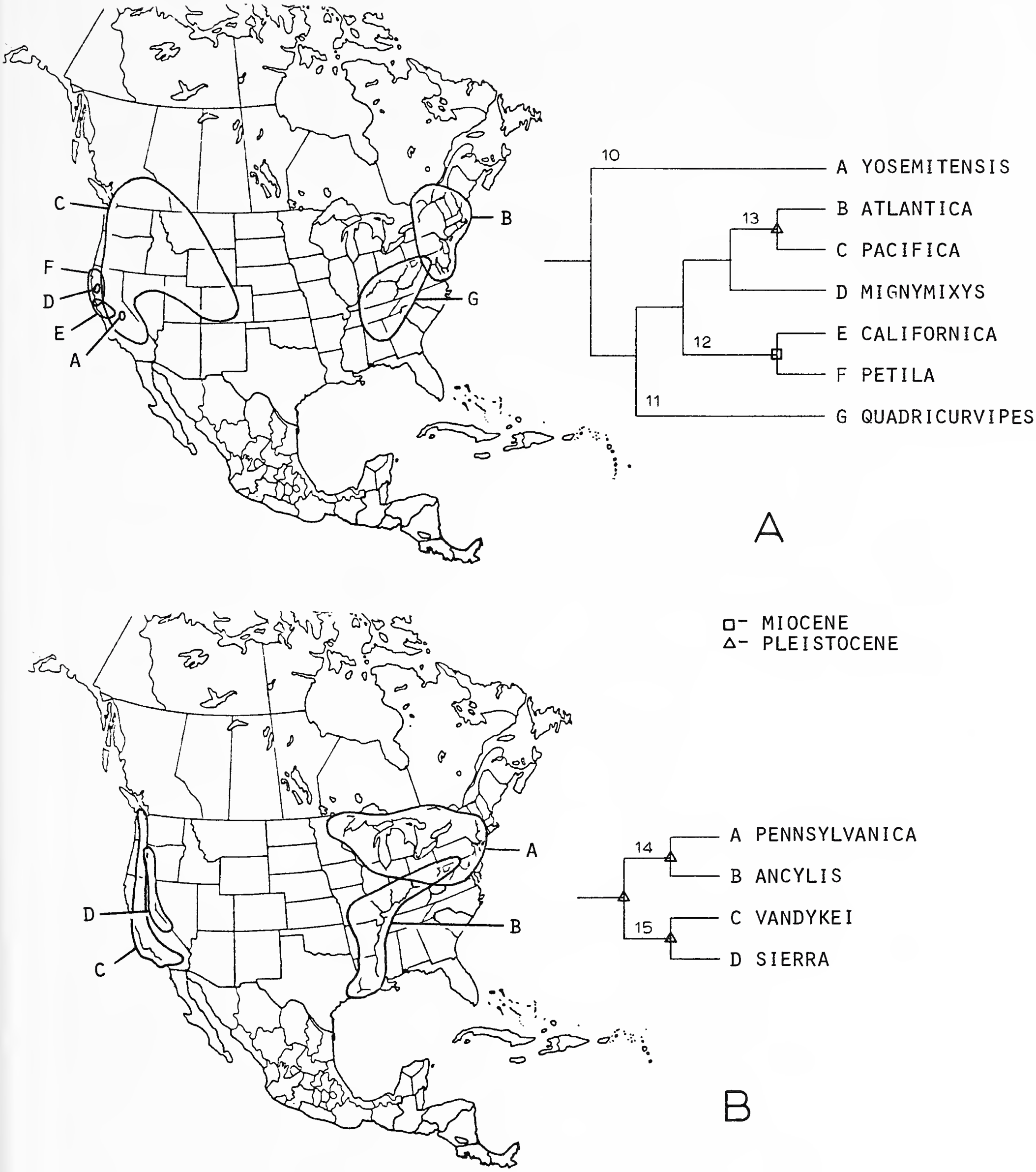
the apex of the main-piece (not the apical lobe) heavily sclerotized on the right side, and more or less enlarged (most greatly so in *angulicollis*); as in the *circulata* complex, two of the three species have long and dense paramere setae (Figs. 24C,D,29D). Males of *Hydraena atlantica* (5) and six other species in its complex (Fig. 165A) have the transparent lobe at the apex of the aedeagus shaped similarly to that seen in the *circulata* complex, that is, the lobe is large in relation to the size of the apical filament; however, the parameres of males in the *atlantica* complex have very sparse and relatively short setae (Figs. 26A,B). The fourth complex includes species associated with *Hydraena pennsylvanica* (6) (Fig. 165B).

Males have the transparent lobe at the apex of the aedeagus small in relation to the apical filament (Figs. 29A-C,30A,B); enlargement of the filament reaches its extreme in *H. ancylis*; *H. sierra* might at first appear to have a large apical lobe and a small filament, but apparently the lobe has enlarged after elongation of the filament, as a comparison with the aedeagus of *H.*





Figs. 164A – B, Generalized geographical distributions and proposed phylogeny of *Hydraena*. (A) *circulata* Complex. (B) *angulicollis* Complex.



Figs. 165A – B, Generalized geographical distributions and proposed phylogeny of *Hydraena*. (A) *atlantica* Complex. (B) *pennsylvanica* Complex.

vandykei clearly suggests, indeed, *H. vandykei* and *H. sierra* are more similar to one another externally than either is to any other species of *Hydraena*.

I associate the *circulata* and *angulicollis* complexes on the basis of their common possession of long and dense paramere setae, whereas the *atlantica* and *pennsylvanica* complexes are united because of their short and sparse setae (Fig. 163C:1,2). This grouping is not supported by a synapomorphy.

Within the complexes, the following character states were used for forming sister-species pairs and sister-groups (numbers refer to those in phylograms, Figs. 64A,B,165A,B): (7) *H. circulata– arenicola* united on the basis of similarity of main-piece shape; (8) *H. occidentalis–tuolumne* united on basis of expanded parameres; (9) *H. angulicollis–appalachicola* united on basis of morphocline of increasing enlargement of apical region on right side of main-piece; (10) *H. yosemitensis* is unique in possession of long spines on the apex of the aedeagus (lateral view); (11) *H. quadricurvipes* is unique in the lack of a slender apical filament of the aedeagus (externally *H. quadricurvipes* is unique among *circulata* Group species in possession of arcuate meso- and metatibiae); (12) *H. californica–petila* united on basis of very slender main-piece of the aedeagus; (13) *H. atlantica– pacifica* united due to overall aedeagal similarity; (14) *H. pennsylvanica–ancylis* united based on mutual possession of very long apical processes; (15) *H. vandykei–sierra* united because the apical lobe is attched to the slender apical process above the point where the latter attaches to the main-piece.

Comparison of geographical distributions of the four complexes in the *circulata* Group reveals two patterns. First, three of the groups have both an eastern and a western North American component, which I view as evidence of vicariance caused by Pleistocene glaciations. Secondly, all three complexes with an eastern component have two species each, one more northernly and one more southernly distributed; two of these north-south pairs are sister-species, which may also relate to Pleistocene glaciations.

The *leechi* Group.

Five Subgroups of the *leechi* Group are recognized, based upon external features. The following character states are used to define the proposed monophyletic groups (numbers refer to those in phylogram, Fig. 163B): (1) this grouping is based on general habitus similarity, I cannot suggest a synapomorphic character state at this time; (2) pronotum with a scintilla (Fig. 31C); (3) males with arcuate hind tibiae (Figs. 32D,E); (4) hind tibiae of males with a brush of setae; (5) hind tibiae with two stiff spines; elytra with alternate intervals elevated; (6) hind tibiae of males straight, lacking a brush of setae; (7) pronotum without a scintilla; (8) anteromedian region of metasternum forming a ridge (Fig. 48D).

Of these criteria, I am confident that 2-5 and 8 represent synapomorphic characters, whereas criteria 1,6 and 7 should be considered likely candidates for modification in future evaluations of relationships in this lineage.

The *leechi* Subgroup. – This is well defined and quite distinctive by virtue of the arcuate and setose hind tibiae of males. Within the lineage, however, differences in external features are generally of an autapomorphic nature and consequently of no value in determining sister-groups. The reconstructed phylogeny (Fig. 166) is based on both aedeagal (Figs. 33A-D,36A-D) and external features, but principally the former. The following character states are used (numbers refer to those in phylogram): (1) *H. canticacollis* is characterized by shape of parameres, which is unique in the group, and setae are distributed

along the entire dorsal edge of the parameres, not just near the apex and on the ventral edge as in males of other species of the *leechi* Subgroup; (2) the aedeagus of *H. scopula* is unique in development of a process near the apex, and in paramere shape; (3) I am unable at present to suggest apotypic character states for these proposed monophyletic groups, which are based on overall external and aedeagal similarity; this similarity however may be due to retention of plesiotypic characters; (4) *H. arizonica* and *H. breedlovei* have the metatibiae of males expanded in the region of the setal brush (Figs. 32D,G), which is considered a derived condition; (5) *H. scintilla* and *H. bituberculata* are united based upon similarity in the aedeagal apex.

Comparison of proposed phylogeny and generalized distributions (Fig. 166) reveals that most sister-groups consist of a northern (southeastern Arizona and southwestern New Mexico) and a southern (central Mexico) component (i.e., *H. scopula*–sister-group, *H. scintilla–bituberculata, and H. arizonica–breedlovei*). Interpreted from a vicariance theory viewpoint, this distribution suggests that some portion of the Sierra Madre Occidental mountains (or an historical antecedent) is a likely candidate as a vicariance barrier.

The *scintillabella* Subgroup. – Males of this subgroup are similar to those of the *leechi* Subgroup in that several species display only aedeagal differences. Consequently, the proposed phylogeny (Fig. 167) is based almost entirely on these genitalic characters. In certain species the aedeagus is so bizarre (*H. zapatina* and *H. colombiana*, Figs. 39C,D) that similarities with the other species are not readily apparent. This also suggests that several species in this lineage still remain to be collected and studied. Reconstructing a phylogeny is further complicated by the fact that five of the 17 species in this lineage are known from only female specimens. The following character states are used to justify the proposed phylogeny (numbers refer to those in phylogram): (1) this lineage has relatively simple aedeagi which are slender in lateral view and lack intricate convolutions in the apical portion (Figs. 37B, 41A-D); (2) aedeagi in this lineage are relatively broad in lateral view and have the terminal portion highly convoluted and extremely complex (Figs. 38A-D,39A-D); (3) in this grouping, the aedeagal main-piece extends as a process at its apex; (4) *H. maureenae–H. ozarkensis* united based upon high degree of overall aedeagal similarity (Figs. 41A-C), additionally, these two species have random punctures on the elytral disc, not serial rows as in the other species, and a basic overall external similarity; (5) in *H. exilipes–H. campbelli* the right side of the aedeagal main-piece is heavily sclerotized and extends well beyond the left side; (6) placement of *H. sordida* and *H. puncticollis* is highly speculative as males are not yet known; (7) these species are proposed as monophyletic because of the tendency of the aedeagus to have an elevated region upon which the parameres insert (see lateral views, Figs. 38A-D); (8) the aedeagus of *H. costiniceps* (Fig.39B) differs in basic structure from that of the aforementioned species, hence its placement; uniting *H. germaini*, *H. paraguayensis* and *H. plaumanni* to this lineage is highly suspect as males are not yet known for these species; (9) species in this lineage have the dorsal process of the aedeagal main-piece well developed; (10) uniting *H. zapatina* and *H. colombiana* is based on their very complex aedeagal structure (Figs. 39C,D), however, this placement is highly provisional and will almost undoubtedly require modification when additional, related species are found; (11) this dichotomy and the *H. alterra– H. terralta* sister-species pair are quite obvious from the aedeagal similarities of these three species (Figs. 38A,C,D).

A comparison of phylogeny and generalized distributions reveals that the first dichotomy corresponds with the northern (North and Central American) and southern (South American) distributions, the only exception being *H. zapatina*, which may not actually belong in the

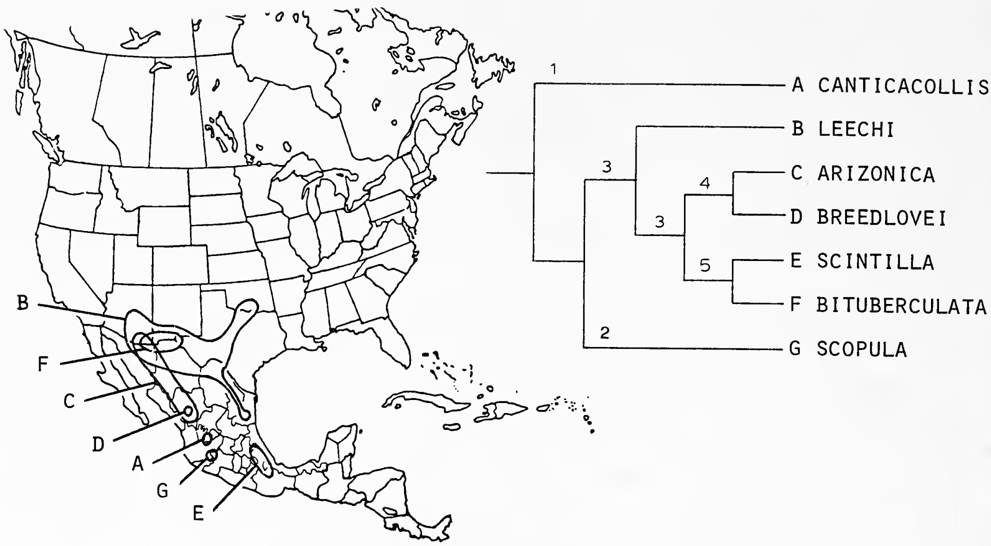


Fig. 166. Generalized geographical distributions and proposed phylogeny of the *leechi* Subgroup of *Hydraena*.

lineage as herein proposed (see above). The distribution patterns of the *H. maureenae– H. ozarkensis–H. exilipes–H. campbelli* lineage closely approximates that of species in the *Hydraena marginicollis* Complex (see below). Concerning the South American species, the phylogeny suggests that species from southeastern Brazil are more closely related to those from Colombia and Peru than to those (somewhat) geographically intermediate species from Paraguay, Bolivia and northern Argentina (*H. costiniceps*, etc.). However, male genitalia are not known for three of these species, so their phylogenetic placement is doubtful. Further, additional species of this lineage from South America surely await discovery.

The *particeps* Subgroup. – Adults in this sublineage of the *leechi* Group lack a pronotal scintilla. Externally they are all quite similar (except *H. oblio*, see below), the reconstructed phylogeny (Fig. 168) being therefore based upon aedeagal structures. Character states below are used to justify the proposed phylogeny (numbers refer to those of phylogram).

(1) Placement of *H. oblio* in this lineage is highly provisional, being based upon lack of a pronotal scintilla. The pronotum is markedly punctate and microreticulate, which could be considered a derived condition for this group. However, this sculpturing may also have resulted in the secondary loss of a scintilla; the aedeagus (Fig. 44A) also differs considerably from that of other species in this lineage, and perhaps indicates relationship with certain species in the *scintillabella* Subgroup. A more defendable phylogenetic placement of *H. oblio* must await further data. (2) Males of this lineage have the parameres originating above the base of the aedeagus. (3) Overall aedeagal similarity of males of these three species (Figs. 44B-D), includes presence of a lobe on the left side of the aedeagus, which is considered apotypic. (4)

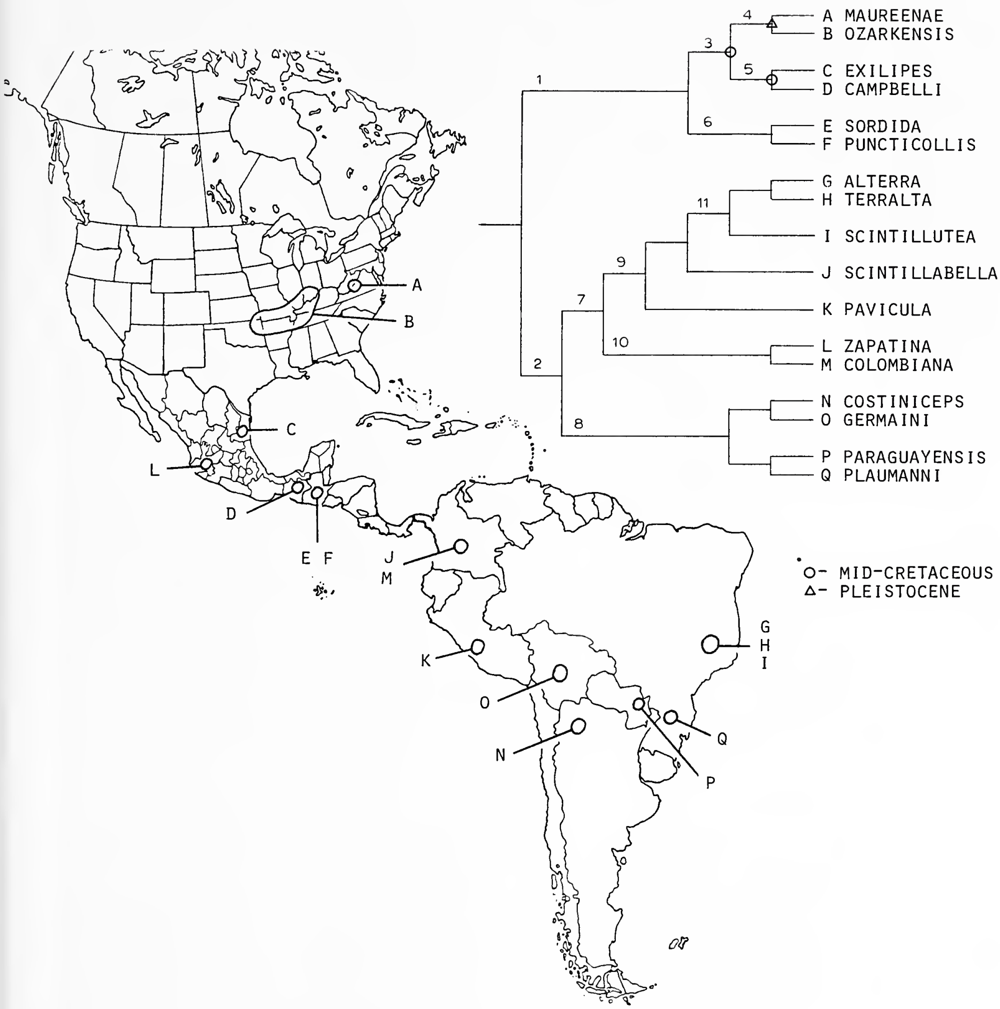


Fig. 167. Generalized geographical distributions and proposed phylogeny of the *scintillabella* Subgroup of *Hydraena*.

Males have the parameres originating just below the modified apex of the aedeagus (Figs. 43A-D,45B). In *H. orcula* the parameres originate lower on the main-piece, but this is thought to be secondarily derived. Males of three of the four species have a slender process at the aedeagal apex, which are considered homologues (*H. youngi* is the exception). (5) These three species share an aedeagal lobe (see lateral views of Figs. 43A-D; lobe lies in front of right paramere). (6)*H. youngi* is thought to be a highly derived member of its lineage, with adults characterized by an unusual, very linear body form and scabrous sculpture on the pronotum. The aedeagus (Fig. 45B) is also quite unusual, I suspect a result of fusion and reduction of various parts (cf.. *H. particeps* aedeagus, Fig. 43A). The morphological gap in aedeagal and external features between *H. youngi* and the species of its sister-group suggests that several

species have become extinct in this lineage. (7) *H. decui* and *H. particeps* are united on the basis of overall aedeagal similarity (Figs. 43A-C). One can mentally visualize the bending and reduction necessary to derive the *H. decui* aedeagus from an *H. particeps*-like precursor. The aedeagus of *H. orcula* males does not easily lend itself to a third step in this type of modification, hence its very reduced structure is thought to reflect early divergence of the stock from which it descended (most of which remain to be collected and described). (8) Males of *H. guadelupensis*, *H. spangleri* and *H. punctata* display three transformation series in aedeagal features (Figs. 44B-D): development of a sclerotized sinuation on the dorsal surface between the parameres (maximum expression in *H. punctata*); increasing width of main-piece (*H. punctata* the extreme); and increasing slenderness of apical filament (*H. punctata* again the extreme). Based on out-group comparison with the other species of the *particeps* Group, the slender aedeagus which lacks a sclerotized sinuation between the parameres would appear plesiotypic. This suggests that direction of change was from *H. guadelupensis* to *H. spangleri* and finally to *H. punctata*, and consequently the latter two species are considered monophyletic.

Comparison of the proposed phylogeny and generalized distributions (Fig. 168) reveals that the Caribbean species, *H. guadelupensis* and *H. decui*, are related to North and South American lineages, respectively. When traced backward, however, both lineages "retreat" in a southern direction, indicating that ancestral species had Central or South American distributions. Are the Caribbean distributions a result of vicariance caused by formation of these islands (see Rosen's hypothesis, 1975), or due to dispersal and divergence after insular formation? If the species dispersed to the islands and then diverged, it would seem logical that the southernmost Caribbean species, *H. guadelupensis*, would have its sister-species in northern South America. Likewise, the species from Cuba, *H. decui*, would probably have its sister-species in Florida and adjacent areas of North America. The exact opposite is true, however, as *H. guadelupensis* is related to *H. spangleri* and *H. punctata* of North America, whereas *H. decui* is related to *H. particeps* and *H. orcula* of South America. One wonders if further collecting will expand the distributions of these Caribbean species.

The *argutipes* Subgroup. – The reconstructed phylogeny (Fig. 169) of this lineage is based on both external and aedeagal characteristics (numbers below refer to those of phylogram). (1) *H. cuspidicollis* differs both externally and genitalicaly from the remaining species in this lineage. Anterior angles of the pronotum (Fig. 48C) are produced, males have a brush of setae on the hind tibiae, and the protibiae are shaped uniquely (Figs. 61G,H), all of which are considered apotypic for this lineage.

The aedeagus of *H. cuspidicollis* (Fig. 45A) is unique in that the left paramere is much shorter than the right, and the main-piece extends well to the left of the mobile-piece. (2) Synapotypic character states are not known for this lineage. (3) Synapotypic character states are not presently known for this lineage either. (4) *H. mazamitla* is here separated based upon the dissimilarity of its aedeagus (Fig. 46B) from aedeagi characteristic of other species. (5) This group of species is proposed as monophyletic based on the large size of the opening at the base of the aedeagus, a very unusual condition and almost surely apotypic for this lineage. (6) *H. bractea* and *H. bractoides* share a very similar and unusual habitus, expanded hind tibiae in males, and very large metasternal plaques. There is little question they are sister-species. (7) Bifid right parameres (Figs. 47A,B) plus ochraceous legs are derived features shared by *H. argutipes* and *H. prieto*. (8) Males of this lineage have lobe-shaped right parameres (Figs. 46A,C,D). (9) *H. oaxaca* and *H. scolops* males share an unusual lobe between the left

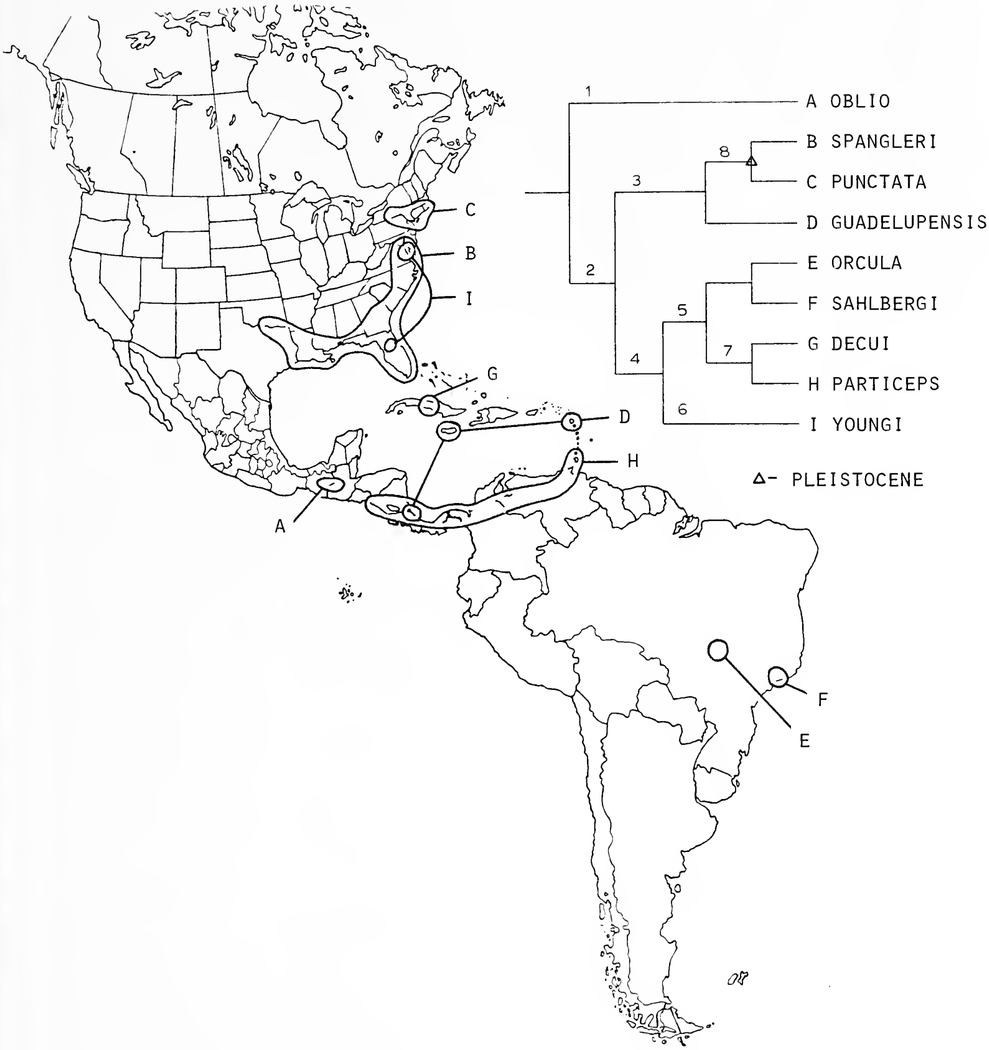


Fig. 168. Generalized geographical distributions and proposed phylogeny of the *particeps* Subgroup of *Hydraena*.

paramere and the main-piece. This lobe inflates when the aedeagus is transferred from glycerin to water.

Interpretation of the generalized distributions (Fig. 169) in light of the proposed phylogeny is difficult due to extensive sympatry. The most clearly defined section of the phylogram (5) is composed of a northern (7) and a southern (8) component, which may suggest a geographically intermediate barrier that was effective in the past.

The *marginicollis* Group.

Although the *marginicollis* Group contains some externally distinctive species, there are many species whose diagnostic features are restricted to aedeagal characters. Two sublineages (Fig. 163D) are recognized, based upon characters of the ventral surface. In one sublineage, the *geminya* Subgroup (1), the prosternal carina is separated from the procoxae by a narrow shelf, and the mesosternal intercoxal process is broad (Figs. 63A,F). In the *marginicollis* Subgroup the pro-and mesocoxae are less widely separated (Figs. 54B,I). These differences relate, in general, to different habitats occupied by these groups (see classification section of the *geminya* Subgroup). More narrowly separated coxae must be considered the plesiotypic condition, therefore synapotypy of the *marginicollis* Subgroup remains to be demonstrated.

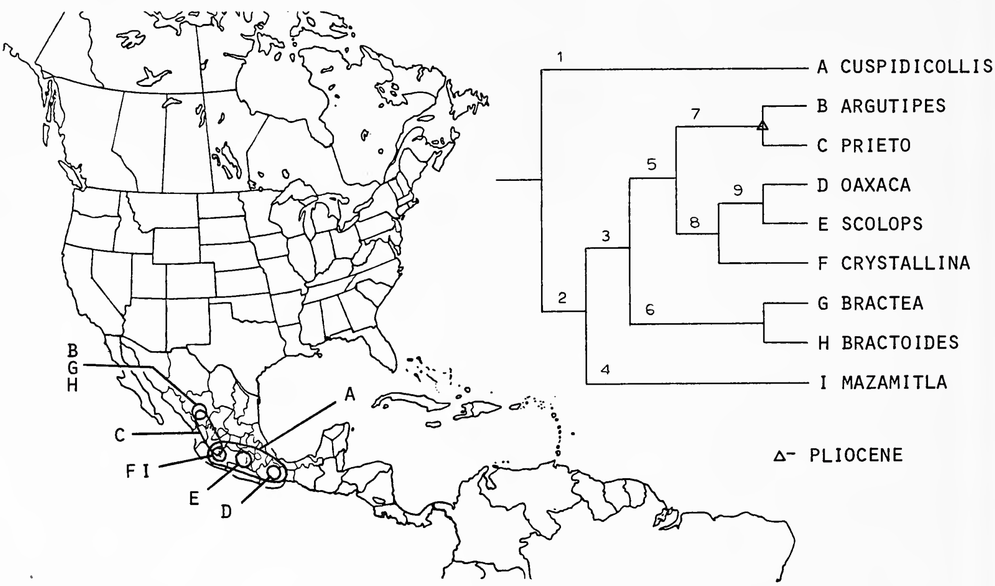


Fig. 169. Generalized geographical distributions and proposed phylogeny of the *argutipes* Subgroup of *Hydraena*.

The *marginicollis* Subgroup. – Six species complexes based upon aedeagal similarities are included in this lineage. Proposed phylogenetic relationships of these complexes (Fig. 163D) reflect an apparent transformation series of positions of the parameres. In the *anisonycha* and *mexicana* Complexes (2,3) the parameres originate at or very near the aedeagal base (*H. mexicana* Fig. 51C); males of the *jivaro* Complex (4) have the parameres near the basal 0.33 of the main-piece (*jivaro*, Fig. 52C); in the *marginicollis* and *trinidensis* Complexes (5) the left paramere is further from the base than is the right (*H. trinidensis*, Fig. 53C); finally, in the

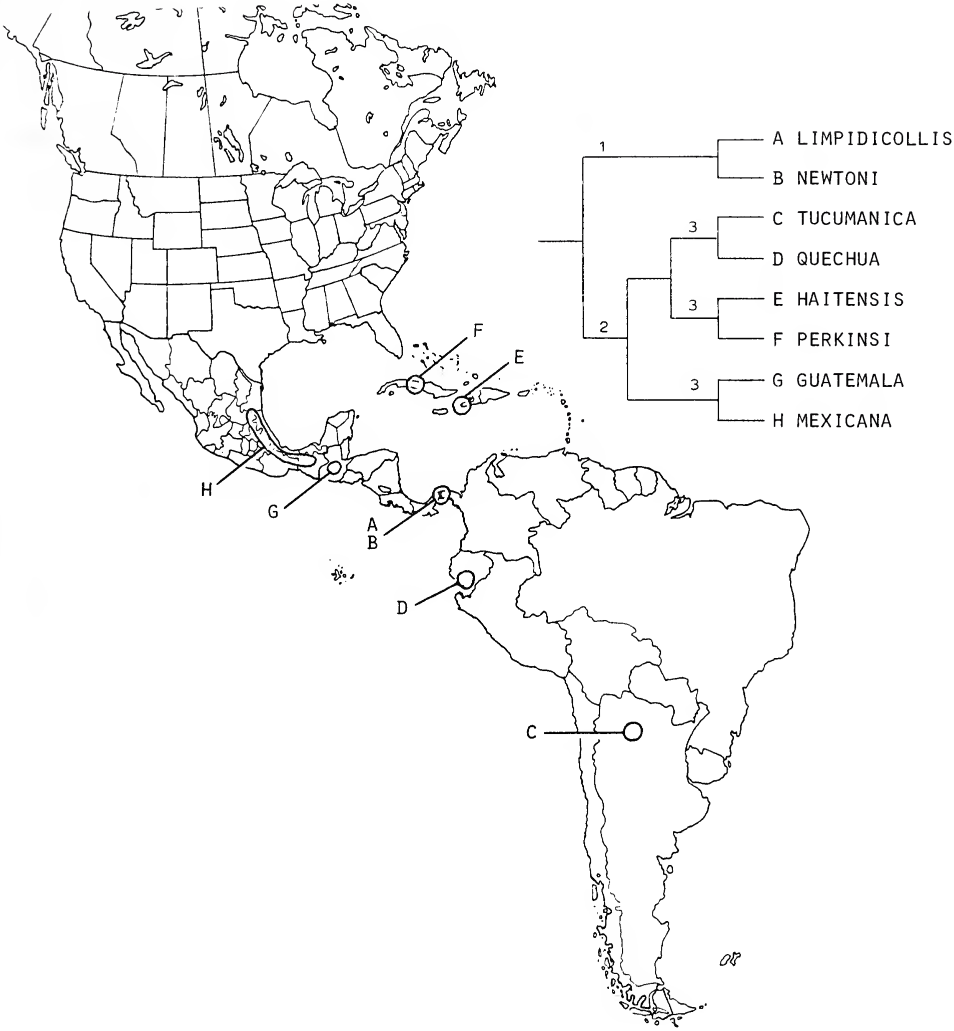
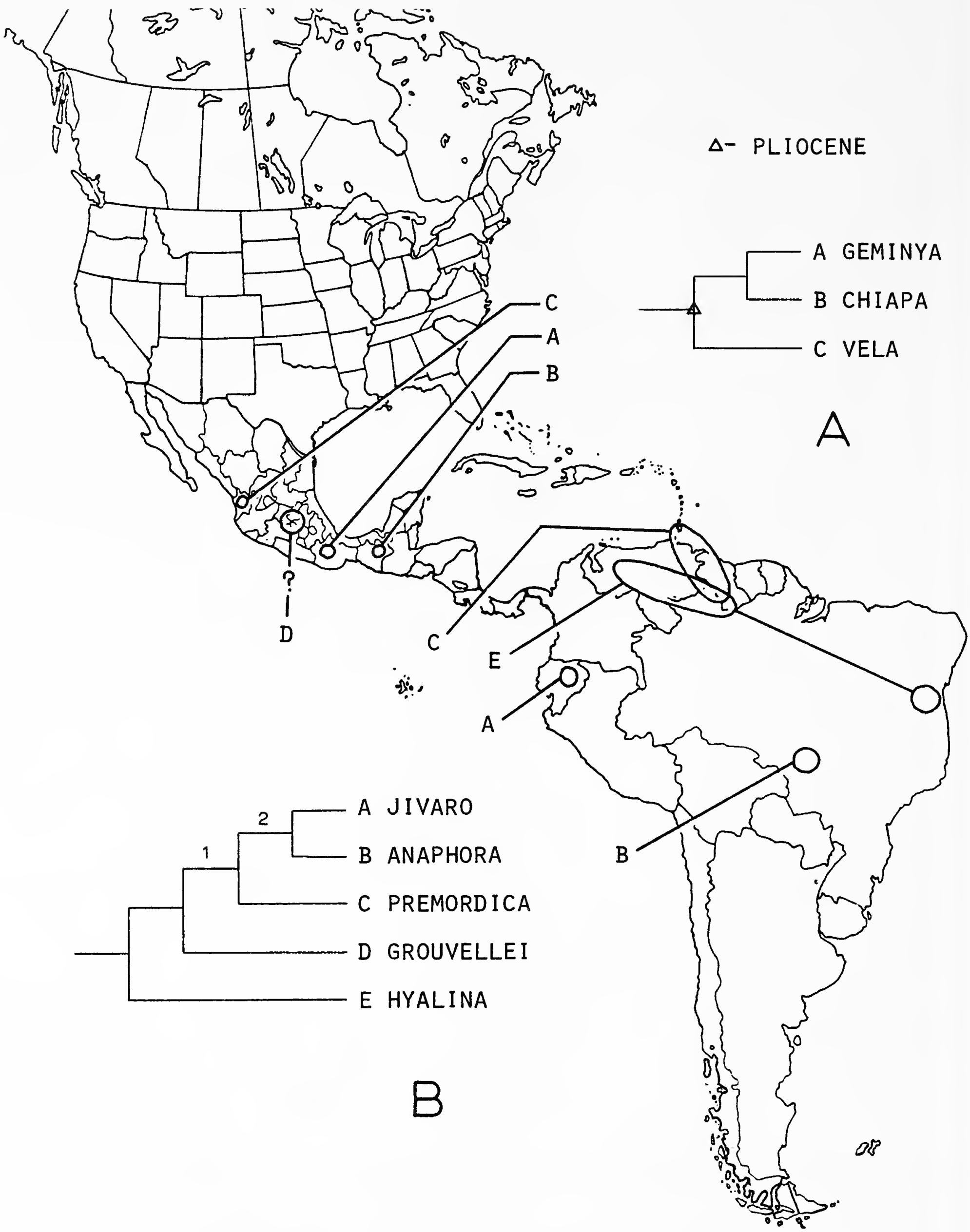


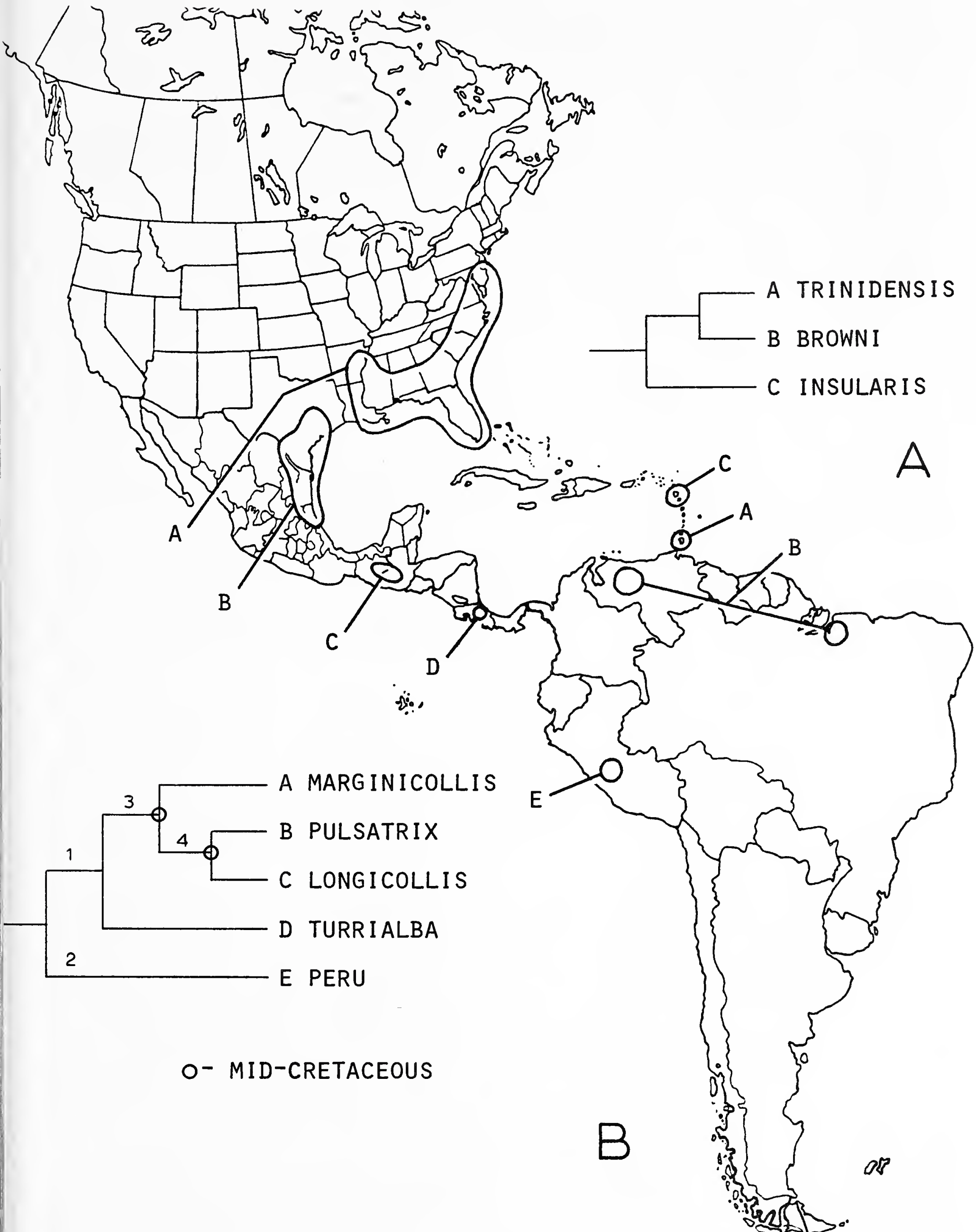
Fig. 170. Generalized geographical distributions and proposed phylogeny of the *mexicana* Complex of *Hydraena*.



Figs. 171A – B, Generalized geographical distributions and proposed phylogeny of *Hydraena*. (A) *geminya* Subgroup. (B) *jivaro* Complex.

colymba Complex (6) both parameres originate above midlength of the main-piece (*H. colymba*, Fig. 60A).

H. anisonycha (2) is placed as the sister-group of the other complexes because of highly unusual external characteristics (see species diagnosis section); also, although parameres attach near the base of the aedeagus (the primitive condition, Fig. 58B) as does the *mexicana*



Figs. 172A – B, Generalized geographical distributions and proposed phylogeny of *Hydraena*. (A) *trinidensis* Complex. (B) *marginicollis* Complex.

Complex, the main-piece differs distinctively in shape from that Complex (some male internal reproductive structures also are unique–see "Internal Reproductive System").

The reconstructed phylogeny for the *mexicana* Complex (Fig. 170) is based on aedeagal

states as follows: (1) the main-piece is straight near the apex in *limpidicollis* and *newtoni* (Figs. 49C,D)(these two species are also unique in that the pronotum is testaceous); (2) in these species the main-piece extends to the right at its apex; (3) these species are assembled on overall aedeagal similarity, and the assembly is provisional (Figs. 49A,B,51A-D).

Comparison of generalized distributions and phylogeny (Fig. 170) reveals no overlap between any of the sister-species pairs. Since this reconstruction is provisional, relationship of the Caribbean species (*H. haitensis* and *H. perkinsi*) to those from South America (*H. quechua* and *H. tucumanica*) must also be viewed as tentative.

The reconstructed phylogeny for the *jivaro* Complex (Fig. 171B) is based on aedeagal similarities (2) and testaceous labrum (1). Although aedeagi of *H. hyalina* and *H. grouvellei* males (Figs. 52A,64A) are similar to those of the remaining three species, I am not confident that their proper phylogenetic position is within this lineage. Clarification of their placement must await discovery of additional, more closely related species. Relating generalized distributions to the phylogeny should be restricted to *H. jivaro*, *H. anaphora* and *H. premordica* aedeagi, (Figs. 52B-D) due to the highly speculative placement of *H. grouvellei* and *H. hyalina*.

Marked similarity of aedeagal form of *H. trinidensis* and *H. browni* males (Figs. 53A-D) is the basis of the reconstructed phylogeny for the *trinidensis* Complex (Fig. 172A).

The reconstructed phylogeny for the *marginicollis* Complex (Fig. 172B) is based upon aedeagal similarities which appear to be synapotypic (Figs. 55A-D,58A): (1) terminal mobile piece with a vesicle; (2) left side of main-piece with a heavily sclerotized lobe; (3) terminal mobile piece with two processes at its apex; (4) overall aedeagal similarity (I cannot demonstrate that this latter criterion is synapotypic).

Comparison of the generalized distributions (Fig. 172B) with the phylogeny reveals that the Central and North American species form the sister-group of the South American species. I suspect that the ancestor of *H. marginicollis–pulsatrix–longicollis* had a wide distribution around the Gulf of Mexico, underwent vicariance to form *H. marginicollis* and the ancestor of *H. pulsatrix–H. longicollis*; a subsequent vicariant event caused the formation of *H. pulsatrix* and *H. longicollis*.

The reconstructed phylogeny for the *colymba* Complex (Fig. 173) is based upon the following criteria (numbers refer to those in phylogram): (1) overall aedeagal similarity (Figs. 60A-D,62A); (2) large body size, pronotum lacking macula, overall aedeagal similarity (Figs. 62B-D); (3) metatibiae of males enlarged; (4) similarity of terminal mobile piece; (5) left paramere reduced in size. With the possible exception of the placement of *H. sabella*, I am fairly confident that this phylogeny closely approximates the true relationships of this complex.

In general, the distributions (Fig. 173) of species in the mountains of Chiapas, Mexico, and those further south in Central America equate with the first dichotomy of the lineage. The high degree of sympatry within the two sublineages, however, prevents further generalizations.

The *geminya* Subgroup. – The reconstructed phylogeny (Fig. 171A) of the three species in this lineage is based upon similarity in aedeagal form of *H. chiapa* and *H. geminya* males (Figs. 64B-D). The widely separated ranges do not permit analysis of the pattern, and probably reflect inadequate sampling of appropriate habitats.

Genus *Spanglerina*

The two sister-species pairs of this genus are clearly indicated by small size, bicolored head, and aedeagal similarities of *S. brevis–frondsicola* (Fig. 174:1), and large size, unicolorous head and aedeagal similarities of *S. ingens–fluvicola* (2).

Rather close similarity of sister-species and distribution patterns suggest a single vicariance event between present day distributions of *S. ingens* and *S. fluvicola*, which could also have formed geographical isolates of the *S. brevis–frondsicola* stem species.

Genus *Limnebius*

Adults of *Limnebius* are extremely similar to one another externally, reliable determinations being based almost entirely on aedeagi, which are highly dissimilar.

Likewise, the reconstructed phylogeny (Fig. 175) must be based entirely on aedeagal form. Aedeagi of males in the upper section of the first dichotomy (1) (*L. borealis*, etc.) have the apical portion more or less lobate and mobile (Figs. 70,71,72A,73C), whereas the apical portion of the aedeagus of the sister-group (2) is generally narrower and firmly affixed to (not hinged with) the basal part (Figs. 72C,D,73A,B). Sister-species are based upon similarities in aedeagal form, some of which are quite obvious (*L. sinuatus–utahensis*, *L. borealis–arenicolus*, *L. piceus–alutaceus*), and in other instances rather obtuse (e.g., *L. mitus–angustulus*). Lack of external characteristics to corroborate the proposed relationships impose a low level of confidence on the phylogram.

The most obvious correspondence between phylogeny and distribution pattern is relationship of eastern species of United States to those in western North America, not to those of Mexico and Texas. The Mexican and Texan species have two sister-group relationships with the species of the western United States: *L. leechi* – (*aridus– mexicanus–octolaevis*) and *L. texanus* – (*arenicolus–borealis*). Therefore, as is seen in *Ochthebius*, the geographical area of southern California and southern Arizona appears a likely location for an event causing vicariance during the past. Also suggestive of a pattern seen in *Ochthebius* is the allopatric distributions of *L. arenicolus–borealis*, separated by areas of Oregon and Washington (the two subpopulations of *alutaceus* discussed in the classification section also reflect this presumed barrier).

Genus *Gymnochthebius*

Proposed phylogenetic relationships of the Subgroups of *Gymnochthebius* are illustrated by Fig. 176B. Numbers on the phylogram represent the following synapotypic character states: 1) absence of hydrofuge pubescence from posterior 0.50 of abdominal sternum 5 and from median area of metasternum; 2) absence of hydrofuge pubescence from anterior 0.50 of of abdominal sternum 5; 3) loss of elytral striae; 4) unusual pronotal form (see Figs. 89D,E); 5) markedly microreticulate pronotum; and 6) similarity in aedeagal form. Unification of the *nitudus–laevipennis* Subgroups as monophyletic requires verification as I cannot suggest a synapotypy at this time. The *oppositus* Subgroup is obviously the more highly apotypic member of this trio,

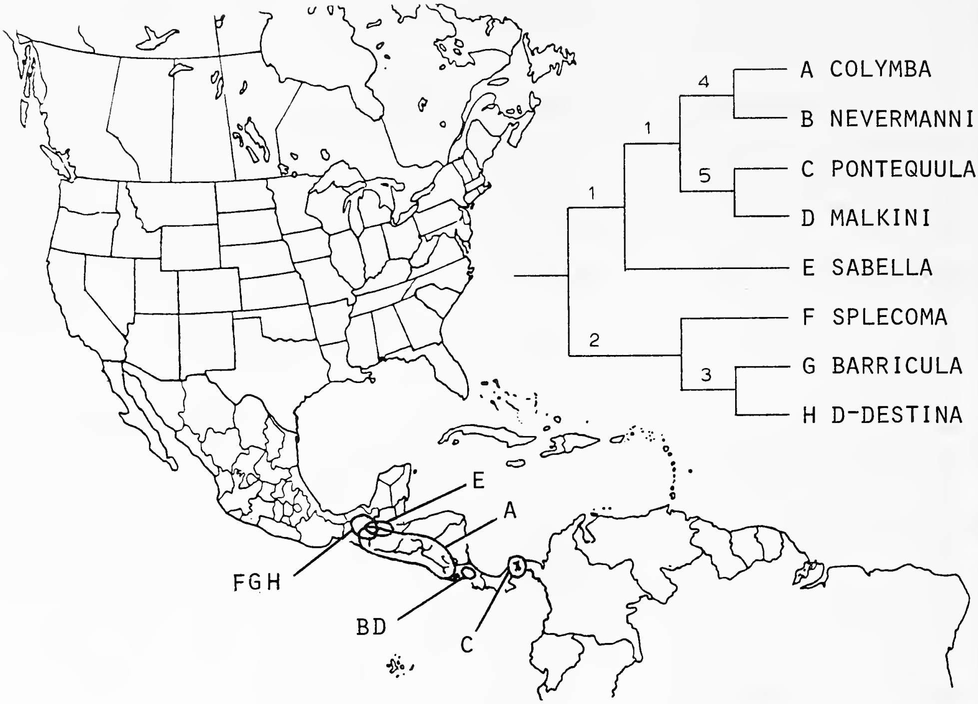


Fig. 173. Generalized geographical distributions and proposed phylogeny of the *colymba* Complex of *Hydraena*.

but there is no morphocline which will allow it to be united with either the *nitidus* or *laevipennis* Subgroup: I therefore view its distinctiveness as resulting from early divergence from the *nitidus* Group stock. The three species in the *plesiotypus* Group retain presumed primitive features of the pronotum and ventral pubescence, but the close resemblance of the aedeagi indicates monophyly.

Generally speaking, *Gymnochthebius* displays increasingly derived morphological states of the Subgroups northward from Chile to the United States. Thus, the *germaini* Subgroup is intermediate in pronotal form between the plesiotypic *plesiotypus* Subgroup of Chile and Argentina and the apotypic *laevipennis* and *oppositus* Subgroups of Central America, Mexico and southern United States; likewise, the *germaini* Subgroup is geographically intermédiate between the aforementioned groups.

The *plesiotypus* Subgroup. – Primitive form of the pronotum of *G. plesiotypus*, which resembles that of certain *Ochthebius (sensu stricto)* species, has been discussed previously. The closely similar body form and aedeagi of *G. jensenhaarupi* and *G. octonarius* clearly indicate monophyly with *G. plesiotypus*. The monophyly of *G. jensenhaarupi* and *G. octonarius* (1) is based upon their close external and genitalic resemblance. The allopatric distribution patterns of the three species also suggest the phylogeny as proposed (Fig. 176A).

The *germaini* Subgroup. – Proposed common ancestry in this lineage (Fig. 177) is based upon similarities in the aedeagus and trends toward reduction of pronotal punctation

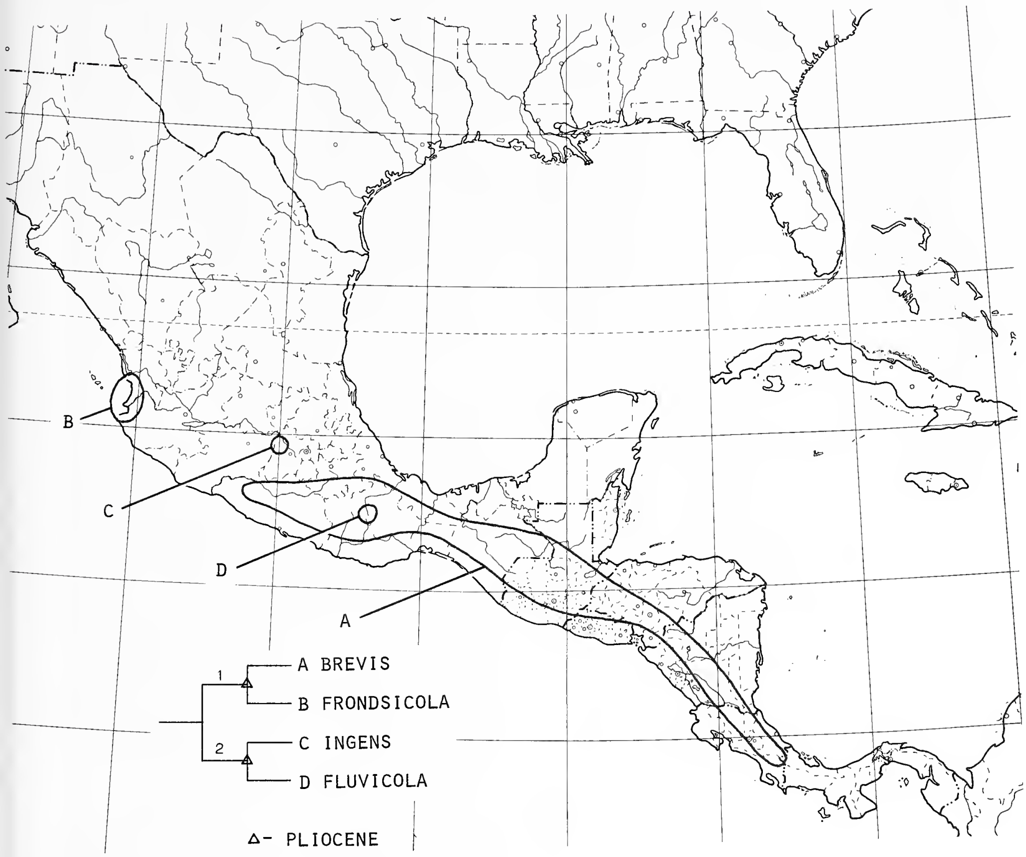


Fig. 174. Generalized geographical distributions and proposed phylogeny of *Spanglerina* species.

(e.g.,*G.tectus–topali*). Members of several species differ noticably only in genitalic characteristics, or vary externally such that the genitalia must be used in identification. This, plus the complex sympatric distribution patterns of the Chilean species makes phylogenetic inferences difficult and consequently of a low level of confidence. The body form of *G. bartyrae* (1) (Fig. 80B) is quite dissimilar from body form characteristic of the remaining species. Likewise, *G. compactus* (2) with its compact body appears distinct from the remaining species of its assemblage. I have seen an additional species (undescribed–no males) related to *G. compactus* from Uruguay, suggesting that these two species may represent a monophyletic vicariant group in the highlands of Brazil and adjacent montane areas of eastern–southern South America. Proposed sister -species pairs for the remaining species of the *germaini* Subgroup are based upon similarities in shape of the aedeagal apex, the two sides of the "fork" being of unequal length in *G. germaini* and *G. bisagittatus* (4) (Figs. 85A,95B), and of equal length (3) in the remaining species. Illustrations (Figs. 84A-D,88B) of the remaining species show similarities between various pairs, but I cannot at present demonstrate defendable

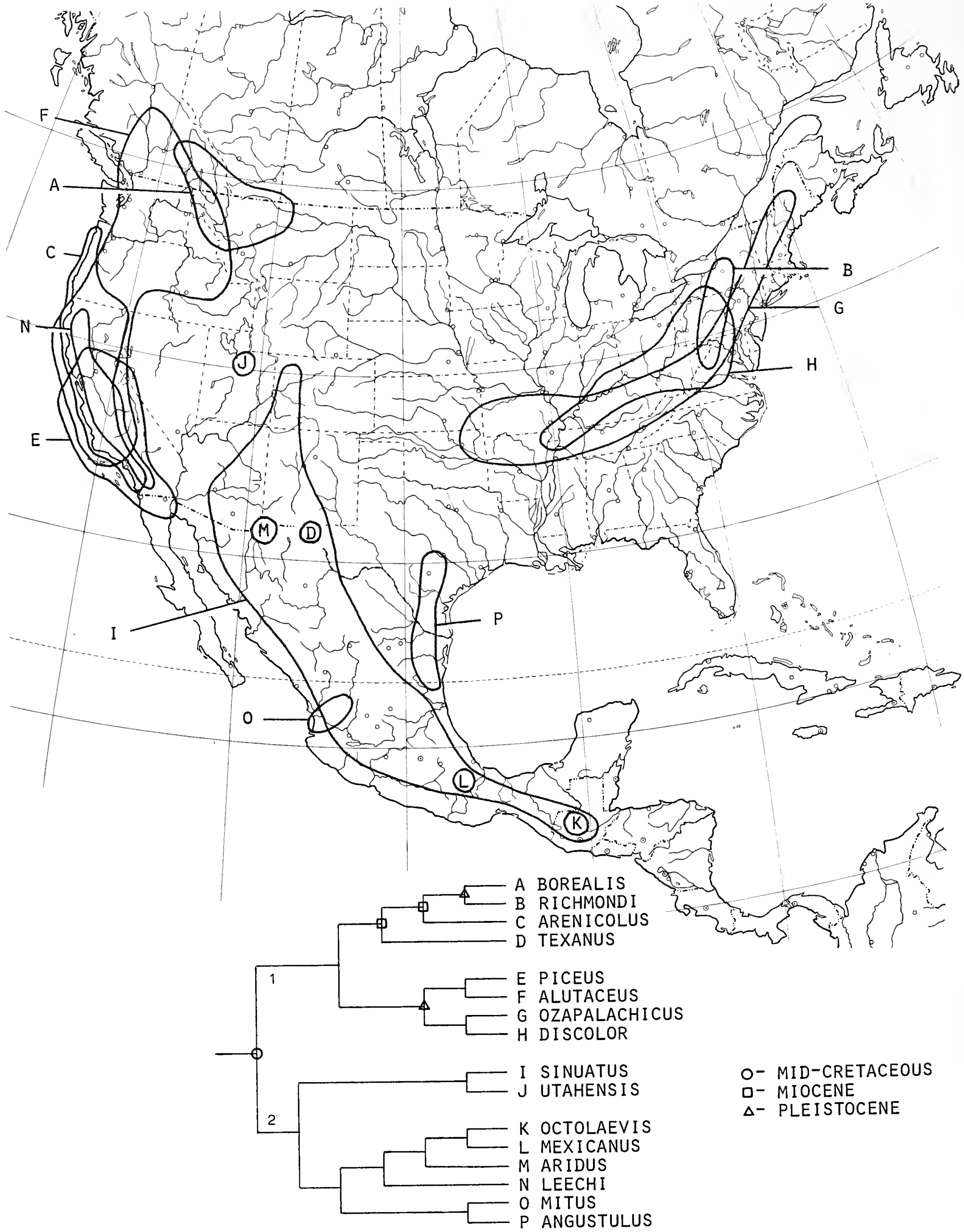
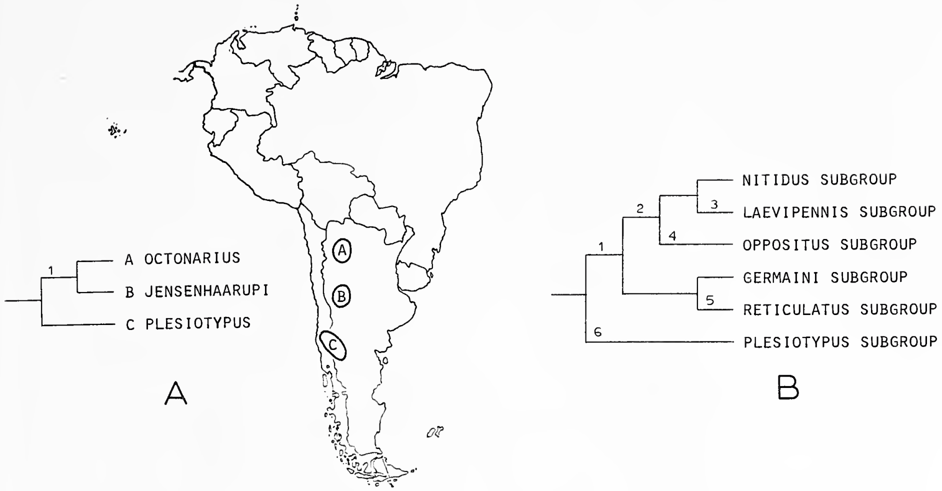


Fig. 175. Generalized geographical distributions and proposed phylogeny of *Limnebius* species.



Figs. 176A – B. (A) generalized geographical distributions and proposed phylogeny of the *plesiotypus* Subgroup of *Gymnochthebius*. (B) proposed phylogeny of major sublineages of *Gymnochthebius*.

synapotypies. We are clearly far from a definitive statement of the phylogenetic relationships of the *germaini* Subgroup.

The *reticulatus* Subgroup. – This highly distinctive Subgroup is currently represented by a single sister-species pair (Fig. 90B). The morphological distance separating this Subgroup from its sister-group (*germaini* Subgroup) suggests that additional related species probably remain to be discovered.

The *oppositus* Subgroup. – Only two species are presently known for this highly derived group (Fig. 94A).

The *laevipennis* Subgroup. – There is an obvious trend toward reduction of dorsal sculpture in this group, as adults of all species lack well impressed rows of elytral punctures. This trend to smoothness is also seen in the pronotum, reduction of foveae presenting a morphocline which can be used to infer relationships (Fig. 178): *G. crassipes–laevipennis* are united (2) by loss of lateral (foveate) depressions, and *G. crassipes–laevipennis– maureenae* are united (1) by loss of posterior foveae. By out-group comparison, the foveate condition is primitive. The allopatric pattern of distribution can also be interpreted as suggesting this branching sequence.

The *nitidus* Subgroup. – The sister-species pair *nitidus–falli* (Fig. 179:1) is based upon the relatively wide median piece of the aedeagus. Shape of the median piece in *G. fossatus* is more similar to that of species in the *germaini* Subgroup. Externally, *G. falli* and *G. fossatus* are more similar, but this similarity suggests symplesiotypy, *G. nitidus* being clearly the more divergent species of the trio. One possible scenario is that the ancestor of the group was probably distributed in Central and/or northern South America, spread northward, forming as the result of a vicariant event *G. fossatus* plus the ancestor of *G. falli–nitidus*. The latter subsequently differentiated, with *G. fossatus* more recently expanding its range northward and southward to its present extent.

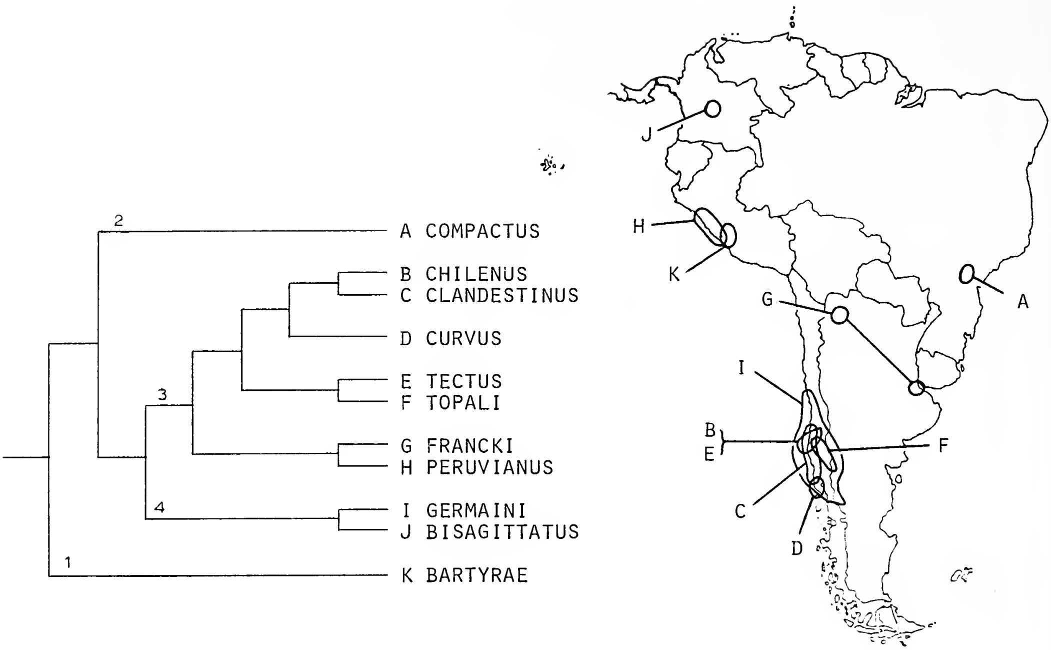


Fig. 177. Generalized geographical distributions and proposed phylogeny of the *germaini* Subgroup of *Gymnochthebius*.

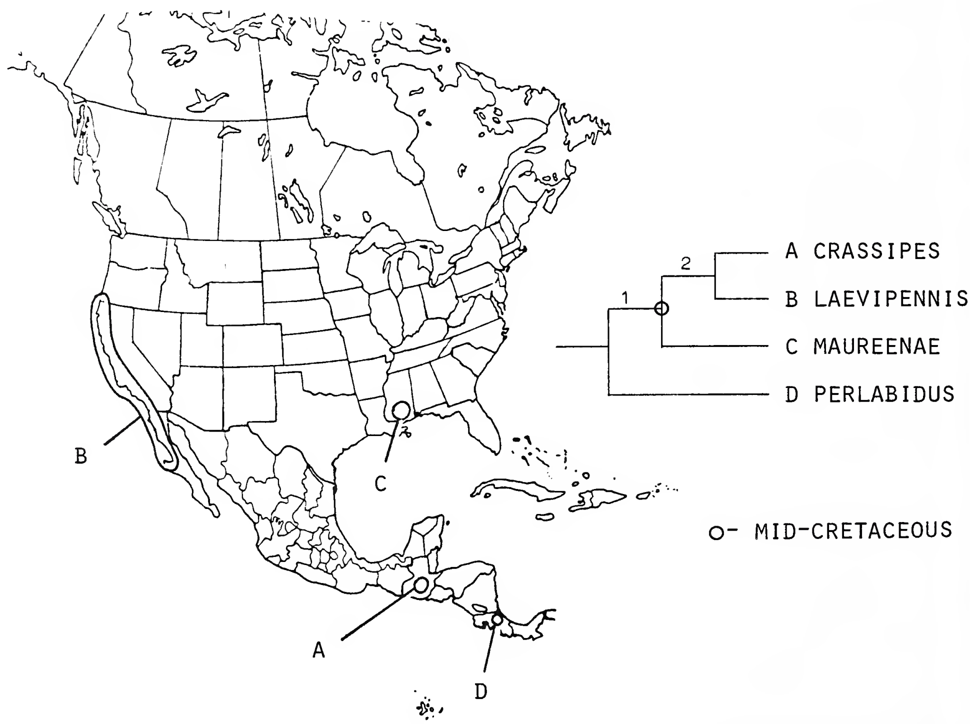


Fig. 178. Generalized geographical distributions and proposed phylogeny of the *laevipennis* Subgroup of *Gymnochthebius*.

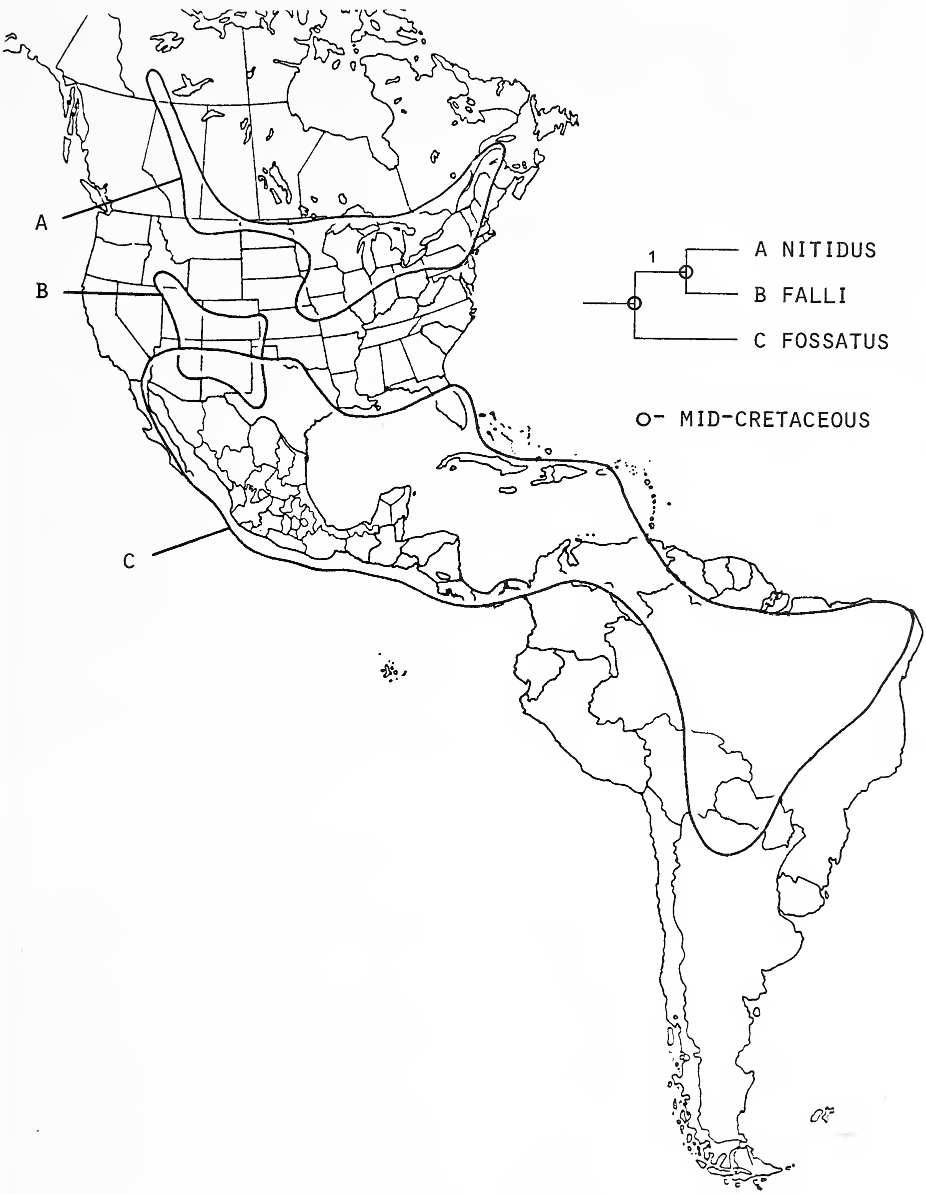


Fig. 179. Generalized geographical distributions and proposed phylogeny of the *nitidus* Subgroup of *Gymnochthebius*.

Genus *Ochthebius*

Ochthebius species in the New World are grouped into two subgenera, *Ochthebius (sensu stricto)* and *Asiobates* (see section on classification). *Ochthebius (sensu stricto)* is best

represented in western North America, but has one major sublineage (*biincisus* Group) which has diversified in Mexico and Central America. *Ochthebius (Asiobates)* also has these two geographical components, but they are approximately equal in species numbers, although the Mexican components are more morphologically diverse.

Subgenus *Ochthebius*

The proposed branching sequences of the major sublineages of *Ochthebius (sensu stricto)* (Fig. 181B) are based primarily on form of pronotum, especially shape of the anterior margin (1). An exception is separation of *O. benefossus* from the remaining species based on unusual sides of the pronotum, which have the hyaline border entirely within the sinuation (2) (Fig. 96D). Additionally, the apical mobile piece of the aedeagus (Fig. 131A) differs from the basic form of the remaining species. The *interruptus* and *borealis* sublineages are united by the straight anterior margin of the pronotum (Fig. 182B:1). The *rectus* Subgroup is joined to the aforementioned by the nearly straight anterior margin, but is distinct from those in shape of the pronotal sides (2) (Figs. 96A,112D-F). The *bisinuatus* Group has the anterior margin of the pronotum bisinuate, which is more closely similar to the form seen in the *interruptus* Group than that of the *biincisus* Group, hence its placement as the sister-group of the former (Fig.181B:3). Finally, the *biincisus* Group is treated as the vicariant (southern vs. northern) sister-group of the *interruptus* + *bisinuatus* Groups (Fig. 181B:4) based on the development of postocular emarginations and processes on the anterior margin of the pronotum (Figs. 125A-F,128A).

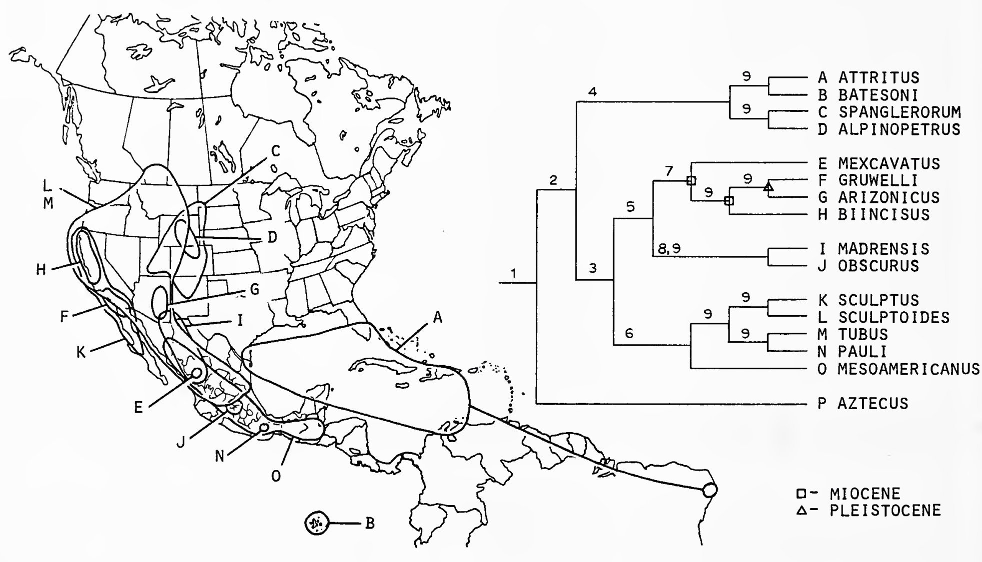
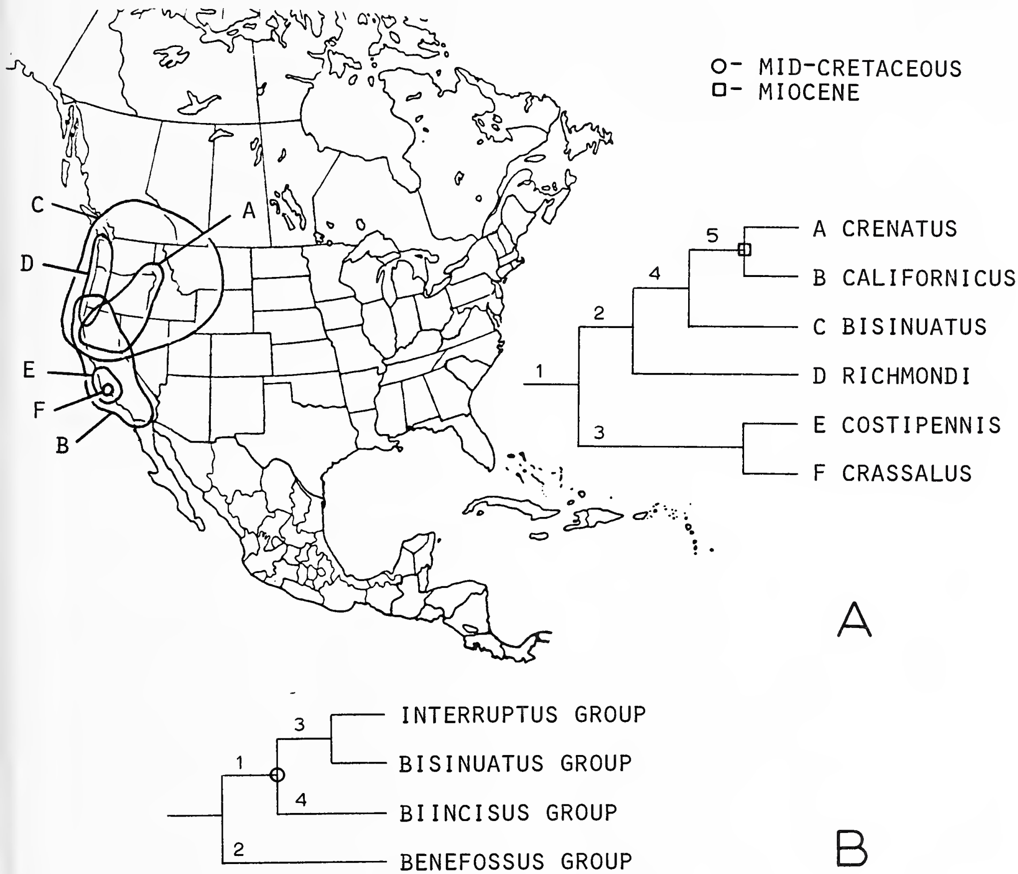


Fig. 180. Generalized geographical distributions and proposed phylogeny of the *biincisus* Group of *Ochthebius (sensu stricto)*.

Obviously I am not applying constraints of equal ranking of sister-groups (e.g., *biincisus* Group ranked equal with *interruptus* Group plus *bisinuatus* Group), the reason being that this proposed phylogeny is meant as the first phase in elucidation of phylogenetic relationships of the sublineages of *Ochthebius (sensu stricto)*, the groups therefore being treated as working units. Equally obvious is lack of synapotypies for the proposed groups, these being based primarily on morphological trends; one trend (morphocline) leading to a markedly bisinuate anterior margin of the pronotum (*O. californicus*, Fig. 116D) and the other leading to well developed postocular emarginations and processes (*O. mexcavatus*, Fig. 128A).



Figs. 181A – B. (A) generalized geographical distributions and proposed phylogeny of the *bisinuatus* Group of *Ochthebius (sensu stricto)*. (B) proposed phylogeny of major sublineages of *Ochthebius (sensu sricto)*.

Both of these groups are thought to be derived from an ancestor with a straight or slightly arcuate anterior margin, hence the *interruptus* Group, which is defined by this criterion, must be considered untested with respect to apotypic characters in common. One possible scenario to explain structure and distributions is: 1) a widely spread species or group of species (with straight anterior margin) diverged to form a northern and southern group; 2) the southern group diverged to form the *biincisus* Group (anterior margin with postocular processes and

emarginations); 3) the northern group (concurrently perhaps) diverged to form the more boreal sublineage and the western *bisinuatus* lineage; 4) the boreal sublineage expanded its range westward, then underwent a vicariant event to form the *rectus* Subgroup in the west and the *interruptus–borealis* stock in the north; 5) the process repeated, with the formation of the *interruptus* and *borealis* Subgroups.

The *benefossus* Group

This monotypic group and *O. (Asiobates) putnamensis* are the only members of the genus restricted to eastern North America (Figs. 99C,186). *O. benefossus* bears a resemblance to Palearctic species in the subgenus *Henicocerus* (see comments in classification section); this, plus absence of other species in eastern North America suggests an ancient, Laurasian distribution pattern. Further study will probably demonstrate that *O. benefossus* is more closely related to Palearctic species than to any of the New World.

The *biincisus* Group

The proposed phylogeny of this lineage, which contains more tropical elements than any other sublineage of *Ochthebius (sensu stricto)* Leach is illustrated by Fig. 180, the numbers representing the following characteristics (presumed apotypic): 1) postocular emarginations present; 2) absence of hydrofuge pubescence on abdominal sternum 6; 3) confluent posterior foveolae of pronotum (a reversal in *O. biincisus*); 4) not demonstrable at this time; 5) reduction of pronotal microreticulation; 6) convex lateral depressions; 7) deep postocular emarginations; 8) loss of median groove; and 9) similarities of aedeagi and habitus.

Some dichotomies have one component north and the other south of the Arizona-Mexico boundary (presently an arid region). Examples are (northern component of each pair given first): *O. gruwelli– arizonicus–biincisus* vs. *O. mexcavatus*; and *O. alpinopetrus–spanglerorum* vs. *O. attritus–batesoni*. Similarily, there is a "dividing line" near the Tropic of Cancer in Mexico which could be viewed as evidence for a single vicariant event resulting in *O. tubus* vs. *O. pauli*; and *O. madrensis* vs. *O. obscurus*.

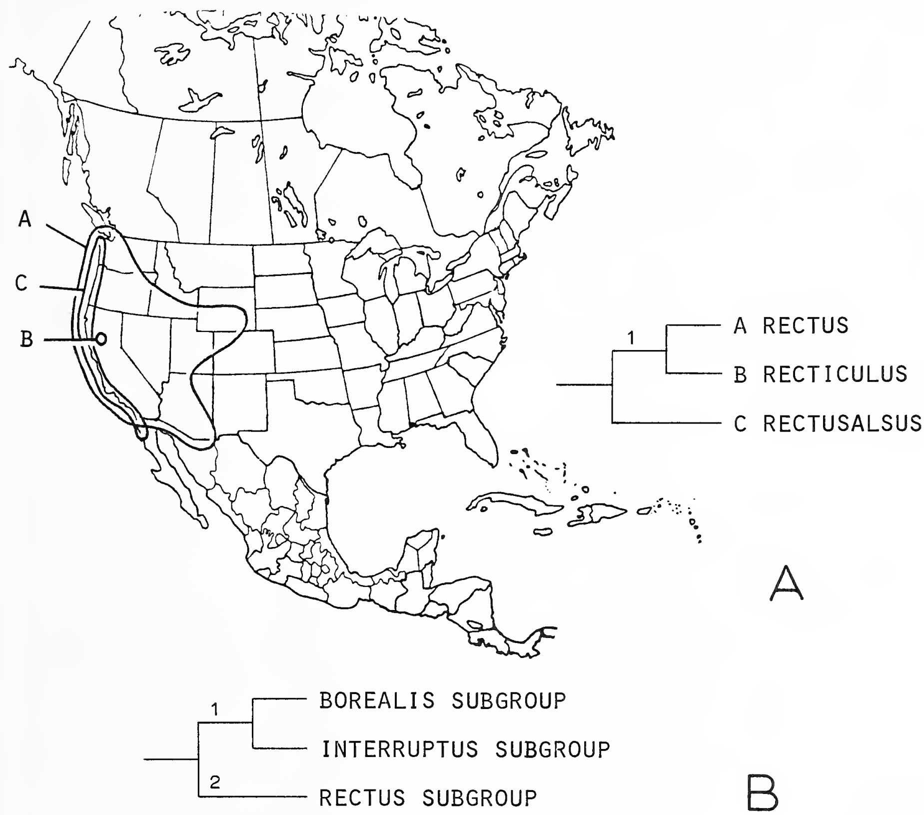
Distribution of the sister-species pair *O. attritus– batesoni*, the former circum-Caribbean, the latter Galapagian, is suggestive of an "eastern Pacific–Caribbean generalized track" (see Rosen, 1975). However, this inference should be tempered by recognition that *O. attritus* is a halophilic species (living in salty pools near beaches) and therefore is more likely to develop an extensive range (as is indicated by the seemingly disjunct Brazilian population). Consequently, the marine barrier between the Galapagos and Central America may be "perfectly matched" for the stem species of this pair, allowing the "chance survivors" model to operate (see discussion in introduction to this section). On the other hand, Rosen (1975) has illustrated this distribution pattern with such divergent organisms as isopods, shrimps, crabs and rats. It would seem highly unlikely that these very different organisms, and also the *O. attritus–batesoni* stem species, would have the same vagility and rate of genetic divergence which would allow this sea barrier to function in each example (*via* the chance survivors model).

The *bisinuatus* Group

The *bisinuatus* lineage trends toward reduction in body size and development of rough pronotal sculpture, the latter trend reaching its extreme in *O. crenatus*. This trend toward rough sculpture is one of the major transformation series upon which the proposed phylogeny (Fig. 181A) is based. The criteria are (numbers refer to those on phylogram): 1) bisinuate

anterior margin of the pronotum (arcuate margin assumed to be the plesiotypic state; 2) I cannot suggest a synapotypy for this group, though *O. richmondi* is isolated by retention of a more primitive habitus; 3) development of widely produced lateral depressions of the pronotum which terminate abruptly posteriorly (Figs. 116A,C); 4) morphocline of pronotal roughness; and 5) crenulations present on anterior margin of pronotum.

Analysis of distribution is complicated by extensive sympatry. However, if sympatry of sister-groups is evidence of dispersal following a vicariant event (Platnick, 1976; Platnick and Nelson, 1978), then it is apparent that the most likely geographical location for such an event (Fig. 181A) is the general vicinity of southern Oregon and southern Idaho. This area separates most of the components of the first dichotomy (except *O. californicus*) and also separates (discounting area of sympatry) the sister-species pair *O. crenatus–californicus*.



Figs. 182A – B. (A) generalized geographical distributions and proposed phylogeny of the *rectus* Subgroup of *Ochthebius (sensu stricto)*. (B) proposed phylogeny of major sublineages of the *interruptus* Group.

The *rectus* Subgroup. – Members of these three species present a habitus (Figs. 98A,112D-F) quite distinct from the other related sublineages of *Ochthebius* (*sensu stricto*). One species, *O. recticulus*, is known only from the overflow area of a thermal spring in

California; the second, *O. rectusalsus*, is apparently adapted to salty ponds near beaches; and the third, *O. rectus*, is widespread in western North America, frequently found in saline pools.

The reconstructed phylogeny (Fig. 182A:1) unites *O. rectus* and *O. recticulus* based upon similarities of the aedeagus of males (Figs. 113B,C,114A). One possible scenario consistent with the distributions, habitats and proposed phylogeny is as follows: 1) the stem species of the lineage was widespread in western North America, containing some ecological components more highly adapted to saline water; 2) a vicariant event, such as decrease in temperature, causes a southward range contraction, leaving a component in warmer coastal ponds (latter to diverge to become *O. rectusalus*), a very small population at Wilbur Hot Springs or other geographically approximate thermal springs (Wilbur Hot Springs has a high degree of endemicity– further support for a vicariance hypothesis)(this component later to become *recticulus*), and finally a southern, less ecologically restricted component (*rectus*); 3) under more favorable environmental conditions, the less ecologically restricted species, *O. rectus*, expands its range to the present limits.

The *interruptus* Subgroup. – Species of this lineage are restricted to western North America; all members have a straight or arcuate anterior pronotal margin and distinct posterior pronotal foveae.

The reconstructed phylogeny (Fig. 183) is based upon similarities in habitus (1), pronotal punctation (3), and color (2) (*O. pacificus–arenicolus* are generally black, the other three species brownish) (Figs. 97A-E).

As was seen in the *bisinuatus* Group, there is a complex pattern of sympatry, especially in California. Further, the vicariant boundary proposed for the *bisinuatus* Group (southern regions of Oregon and Idaho) also appears to be that region most likely involved in vicariance of *interruptus* Subgroup species.

The distribution pattern of *O. lecontei* is unique among the hydraenids of this region, from which might be inferred that the *O. lecontei–sierrensis* species pair is an example of the "chance survivors" model. These two species are separated by the Great Basin.

The *borealis* Subgroup. – This lineage contains primarily cold adapted species which are typically found in pond habitats. Two species, *O. kaszabi* and *O. marinus* are the only members of the family known to have a holarctic distribution pattern.

The reconstructed phylogeny (Fig. 184) is based upon the following synapotypies: 1) confluent posterior foveae of the pronotum; 2) loss of median groove; 3) development of confluent pronotal foveae of a side to form sinuate lines; 4) similarities of aedeagi; and 5) similarities of pronotal microreticulation.

Remains of *O. marinus* (or *O. kaszabi*) in late Pleistocene deposits of Canada (age of deposits = 100,000 years; see comments in "Zoogeography at the Generic Level" section), establish that at least one of these two species had evolved prior to the Pleistocene. This information plus present day distributions suggests that both species were holarctic prior to the Pleistocene. What effect upon speciation in this Subgroup did glacation have? Perhaps the stem species of *O. marinus–uniformis–borealis* was "cleaved" by advancing ice sheets to form *O. marinus* and the stem of *O. uniformis–borealis*.

A problem species in this lineage is *O. lineatus* which, unlike the remaining species, extends southward into tropical regions where it is a rather distinctive morph (see section on classification). Possibly possession of confluent posterior foveae of the pronotum (which are used to place it in the *borealis* lineage) is an example of convergence, as the southern morph of this species in other respects resembles *O. attritus* of the *biincisus* Group.

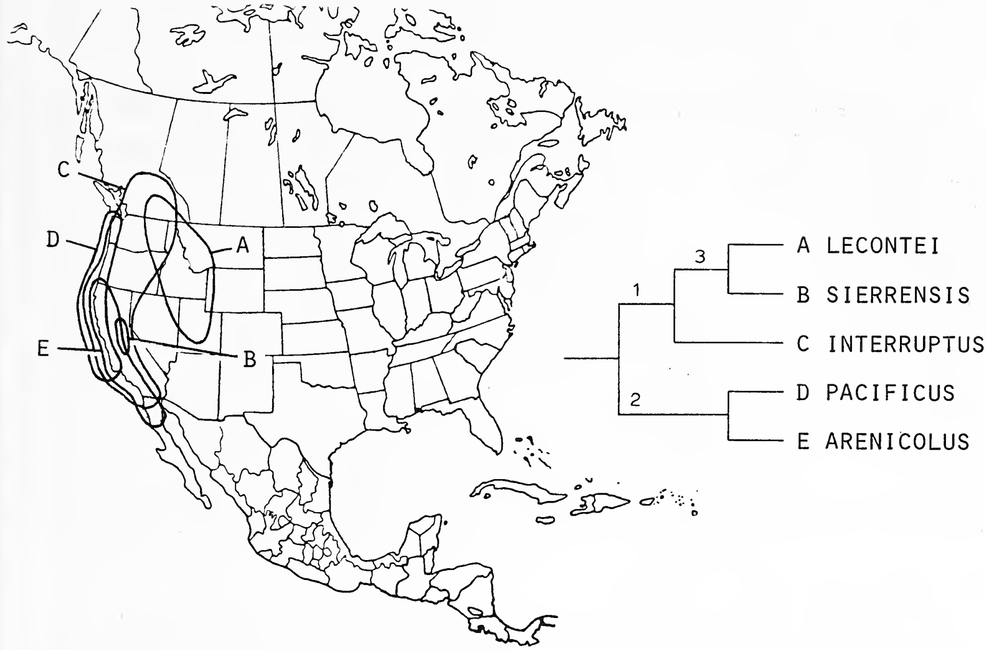


Fig. 183. Generalized geographical distributions and proposed phylogeny of the *interruptus* Subgroup of *Ochthebius (sensu stricto)*.

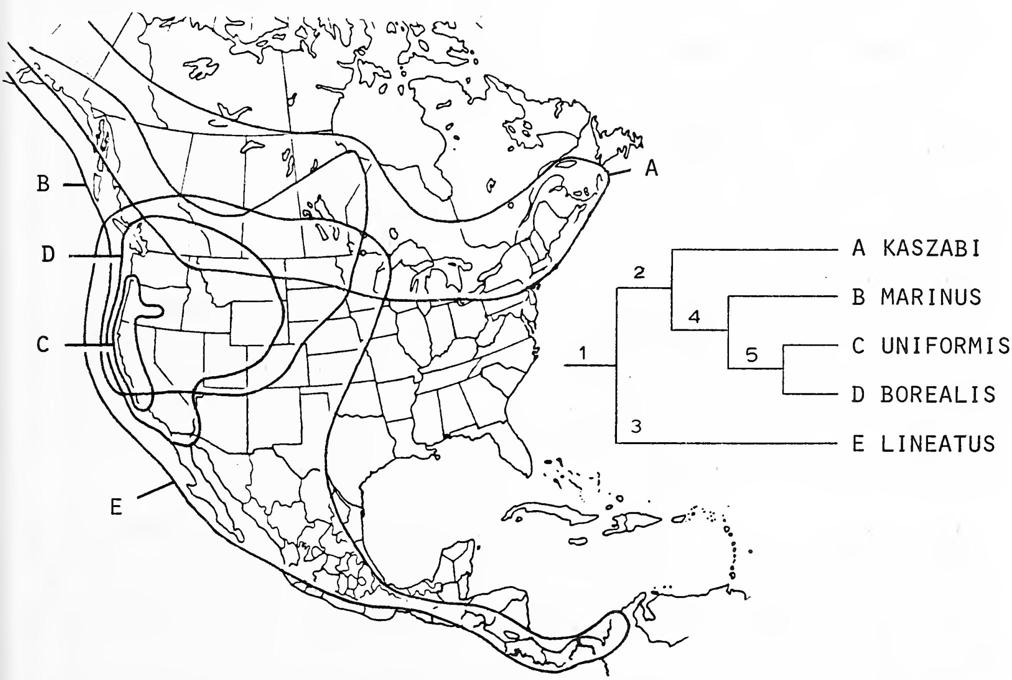


Fig. 184. Generalized geographical distributions and proposed phylogeny of the *borealis* Subgroup of *Ochthebius (sensu stricto)*.

Subgenus *Asiobates*

The subgenus *Asiobates* includes the *puncticollis* Group, which contains large, coarsely punctate adults with a similar aedeagus, and the *discretus* Group, including small adults, generally less coarsely punctate and with a different aedeagal type. The reconstructed phylogeny (Fig. 185B) of the Groups and Subgroups is based upon the following (numbers refer to those given in the figure): 1) aedeagus with a process on terminal mobile piece (*discretus* Group); 2) body large, males similar in details of the aedeagus (Figs. 144A-E); 3) anterior foveae of pronotum present or region coarsely punctate and depressed; 4) anterior foveae, and also posterior foveae in some specimens, absent, body form and aedeagus similar.

The allopatric distribution of a northern and a southern component of nearly all sister-groups within this lineage invites the inference that a single vicariant event in the southwestern United States (or a cyclic environmental change in this region) has had a marked influence on dichotomies within the lineage. For example, the following north-south sister-groups are separated by this geographic region: *discretus* Subgroup – *reticulocostus* Subgroup; *cribricollis* Subgroup – *similis* Subgroup; *puncticollis* species – *angularidus* species.

The *puncticollis* Group.

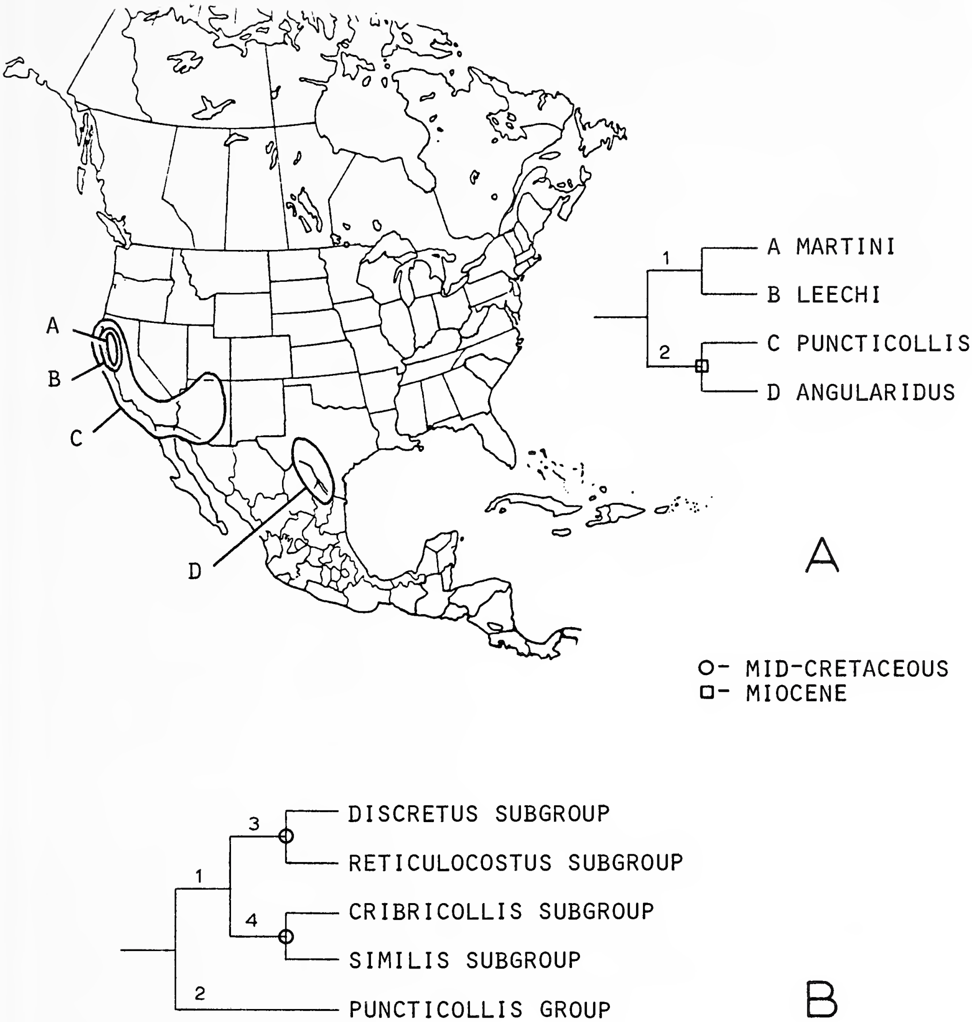
This lineage of distinctive, large (about 2.50 mm long) species is restricted to the western United States, with one disjunct species (*O. angularidus*) in the Rio Grande River drainage of southern Texas and northern Mexico. The species *O. martini–leechi* are united (Fig. 185A:1) by the relatively flattened pronotum (a more convex type considered primitive), whereas *O. puncticollis–angularidus* are united (2) by general habitus resemblance, including well developed pronotal foveae, and genitalic resemblance.

Distribution patterns and proposed phylogeny suggest two vicariant events, the first occurring in southern California and adjacent Arizona, dividing the stem species of the Group into a population in the northern coastal region of California (*O. martini–leechi* stem species) and a population farther south (*O. puncticollis–angularidus* stem species); and a second, subsequent vicariant event occurring somewhere between the current ranges of *O. puncticollis* and *O. angularidus* causing that dichotomy (with subsequent range expansion of *O. puncticollis* to its present limits).

Given a different phylogeny, for instance uniting *O. leechi–puncticollis–angularidus* as a monophyletic group could suggest this scenario: an ancestral species, with a distribution similar to that of *O. puncticollis* today, moving southward due to decrease in temperature, leaving small populations in warmer coastal areas (to become *O. martini*), in thermal springs (to become *O. leechi*), followed by a northward expansion of the southern population under favorable conditions, and subsequent vicariance of *O. puncticollis–angularidus*.

The *discretus* Subgroup. – The reconstructed phylogeny (Fig. 186) is based primarily upon similarities in aedeagal features (2,3) and secondarily upon habitus resemblances (1). The proposed position of *O. putnamensis* is provisional as males are unknown for that species. Overlapping patterns of sympatry in Oregon make that region a likely candidate for an inferred vicariant event.

I have seen fossil fragments of a species which is probably *O. discretus* or *O. hibernus* from Ontario (age ca. 70,000 years – see Morgan, 1972), indicating a more eastern distribution



Figs. 185A – B. (A) generalized geographical distributions and proposed phylogeny of the *puncticollis* Group of *Ochthebius* (*Asiobates*). (B) proposed phylogeny of major sublineages of *O.* (*Asiobates*).

pattern in the past for this Subgroup. This may partially explain the disjunct distribution of the eastern *O. putnamensis*.

The *similis* Subgroup. – The single species known for this group, based upon external features and aedeagus, is closely related to the *cribricollis* Subgroup (Fig. 187A) (see classification section for further comments).

The *cribricollis* Subgroup. – Only two species are currently known for this group, both of which have a northern distribution pattern (Fig. 187A). Previous authors placed *O. cribricollis* in the subgenus *Homalochthebius* (see section on classification).

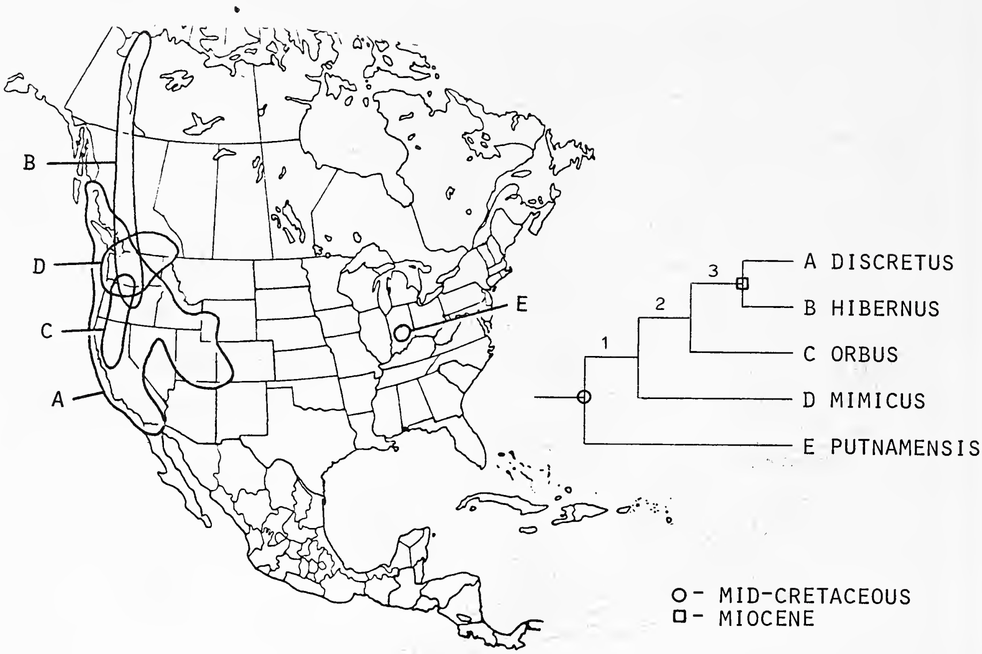


Fig. 186. Generalized geographical distributions and proposed phylogeny of the *discretus* Subgroup of *O.* (*Asiobates*).

The *reticulocostus* Subgroup. – Lack of correspondence between external resemblances and aedeagal structure in this group makes phylogenetic inference difficult. For example, although *O. reticulocostus* and *O. mexicanus* are similar in possession of costate elytral intervals, certainly a derived character state in this group, the other external features of these two species (Figs. 140A,C) and the aedeagi (Figs. 141A,C) are quite dissimilar. A number of autapotypic characters, such as the two apical aedeagal processes of *O. apache*, the lack of a process in *O. mexicanus*, and fusiform body shape of *O. apicalis*, do not aid determination of sister-species relationships (although they may as further species are discovered and described). The basal lobe of the aedeagus common to *O. apache* and *O. reticulocostus* must be considered primitive as it is present in the out-group (*discretus* Subgroup), however, absence of this lobe can be used to unite *O. mexicanus–browni*(Fig. 187B:3).

The phylogeny I have proposed (Fig. 187B) is based partially on body size and form (1), and partially on aedeagal similarities (2). This phylogeny is provisional and I suspect that other, as yet undescribed, species will eventually make possible an interpretation of the present confusing pattern of morphological features.

Accepting this phylogeny, the distribution patterns suggest two locations for vicariant events: 1) between the present distributions of *O. apicalis* and and *O. reticulocostus*, and 2) between *O. apache* and *O. reticulocostus*. The latter region, near the Tropic of Cancer, corresponds with that also suggested by components of the *biincisus* Group of *Ochthebius* (*sensu stricto*) (see above). (I have made a conscious effort to avoid circularity inherent in basing phylogeny on allopatric distributions and then using that phylogeny to support allopatric

speciation.)

Genus *Meropathus*

The single New World species of this genus, *M. vectis*, is most closely similar to *M. campbellensis* from the Campbell Island of the New Zealand subregion, and less so to *M. chuni* from the Kerguelen Island group. However, evolutionary classification of these similarities must await a complete review of the genus.

Genus *Neochthebius*

The two intertidal species currently known for this genus, *N. granulosus* from Japan and *N. vandykei* from the Pacific coast of North America, are very similar sister-species.

Coincident Sister–Group Patterns, Vicariance Zones, and Endemism

"Sweet are the uses of adversity."(Shakespeare, *As you like it*)

Croizat (1958, 1964), Croizat, Nelson and Rosen (1974), Rosen (1975, 1978) and Platnick (1976) (among other papers by these authors) have used Croizat's method of plotting geographical distributions of species or monophyletic groups of species, then joining these distributions by lines to form "tracks".

Rosen (1975) states: "A track is no more than a line on a map connecting the disjunct populations of a species or the disjunct species of a monophyletic group. Thus, a line may be drawn between the distribution of a monophyletic group of species and that of its sister-group of one or more species. Plotting on a map the distributions of many different animal and plant assemblages from a certain region will demonstrate if commonality of distribution pattern occurs. If it does occur, the individual tracks will coincide to from a single pathway of massed tracks. This pathway, or generalized track, may be straight, curved, or irregular, but will be identifiable as a generalized track to the extent that all of its components share the same boundaries."

Tracks therefore join sister-groups and, theoretically, span geographical areas which, at some past time, have undergone drastic geological and/or biological modification. Plotting tracks is hindered by extensive areas of sympatry displayed by putative sister-groups. By vicariance theory, sympatry of sister-species and/or groups indicates dispersal following a vicariant event. Dispersal, therefore, obscures locations of past vicariant events. Because of dispersal in Western Hemisphere Hydraenidae, I have elected to illustrate geographical sister-group relationships in a slightly different way.

As mentioned at various points in the previous section detailing phylogenies, geographical relationships of certain sister-groups within Western Hemisphere Hydraenidae are repetitive. That is, some geographical *vicariance zones* are indicated by more than one sister-group relationship. Some lineages within a genus and/or different genera indicate the same vicariance zone.

A vicariance zone is no more than the geographical area separating sister-groups, and therefore corresponds to the "middle" of individual or generalized tracks.

Validity of a proposed vicariance zone might logically be measured by number of

sister-groups separated by that geographical area. Further, an estimation of faunal composition for a given geographical region in the past, and relative ages of phylogenetic dichotomies can be inferred for the sister-group pairs (*synvicariads*?) of a vicariance zone.

Figure 188A is a summary of the vicariance zones inferred from phylogenies and generalized distributions of hydraenid beetles presented in Figs. 162-187. Arrows in Fig. 188A indicate locations of sister-group elements separated by a given vicariance zone. For example, Vicariance Zone 7 is inferred from the two synvicariads *Hydraena exilipes–campbelli* (Fig. 167) and *Hydraena pulsatrix–longicollis* (Fig. 172B).

The number of sister-groups supporting these vicariance zones varies from one to eight. Most North and Central American vicariance zones are represented by two or more synvicariads, whereas all vicariance zones proposed for South America, except one, are at present supported by only a single sister-group. The lack of synvicariads for South American zones may be real or a result of inadequate sampling. Indeed, some of the vicariance zones indicated by present species ranges may be significantly modified when additional distribution data are obtained for South America. Certainly additional vicariance zones will be identified in South America as the fauna is better sampled. Less modification of proposed Central American vicariance zones is anticipated, and very little change for North American zones.

Phylogenies and geographical distributions supporting the vicariance zones of Fig. 188A are as follows (numbers of Figures in parentheses): 1 (164B, 165A,B, 172B, 175, 178,179,186). 2 (164A, 175, 181A, 183). 3 (165A). 4(180). 5 (175,180, 185A,B, 187A). 6 (165B,167, 168). 7 (167, 172B), 8 (169, 174, 187B). 9 (169, 171A, 174, 187B). 10 (170, 171A, 173, 175). 11(173, 178). 12 (173). 13 (170). s14 (172A). 15 (172B). 16 (171B). 17 (171B, 177). 18 (167). 19 (176A). 20 (176A). 21 (168). 22 (162). 23 (162). 24 (167).

These vicariance zones of hydraenid beetles need not coincide with those of other groups, as vagility and responses to environmental change vary from group to group. As Rosen (1978) puts it, "..a vicariant event separating two once-connected streams will affect the fishes and aquatic invertebrates, but not necessarily the birds that feed on them."

Do these vicariance zones correspond to known paleogeological events? Some North and Central American vicariance zones seem to relate to Cretaceous and Cenozoic geological events which will be discussed below. Most vicariance zones proposed for Central America, and all of those proposed for South America are considered highly provisional; no attempts will be made herein to relate them to past geologic events or to vicariance patterns of other organisms. They will serve at this time, however, as part of the growing data base of vicariance theory.

Vicariance Zone 1. – (Fig. 188A) This corresponds in general location to a shallow sea which covered part of North America during the late Mesozoic and into early Cenozoic times. At its maximum transgression in mid-Cretaceous time the *Epicontinental Seaway* extended from the Gulf Coast to the Arctic and from Minnesota to western Wyoming. At this samė time (ca. 100 MYBP) sea water flooded about one-third of the present land area of the earth (but not eastern and western mountains of North America). By the end of the Cretaceous the Epicontinental Seaway had retreated to the present Plains region. Contraction continued into early Cenozoic time until the waters parted and drained completely from the craton both northward and southward (Dott and Batten, 1976). From the geologist's point of view, "the Cretaceous flood affected North America profoundly" (Dott and Batten, 1976:362).

Rosen (1975, 1978) suggests that this Epicontinental Seaway ("Cannonball Seaway" in 1978 paper) acted as a vicariant event "that affects the North American and encroaching southern elements in the Gulf coastal region of North America" (1975:453). Rosen (1978)

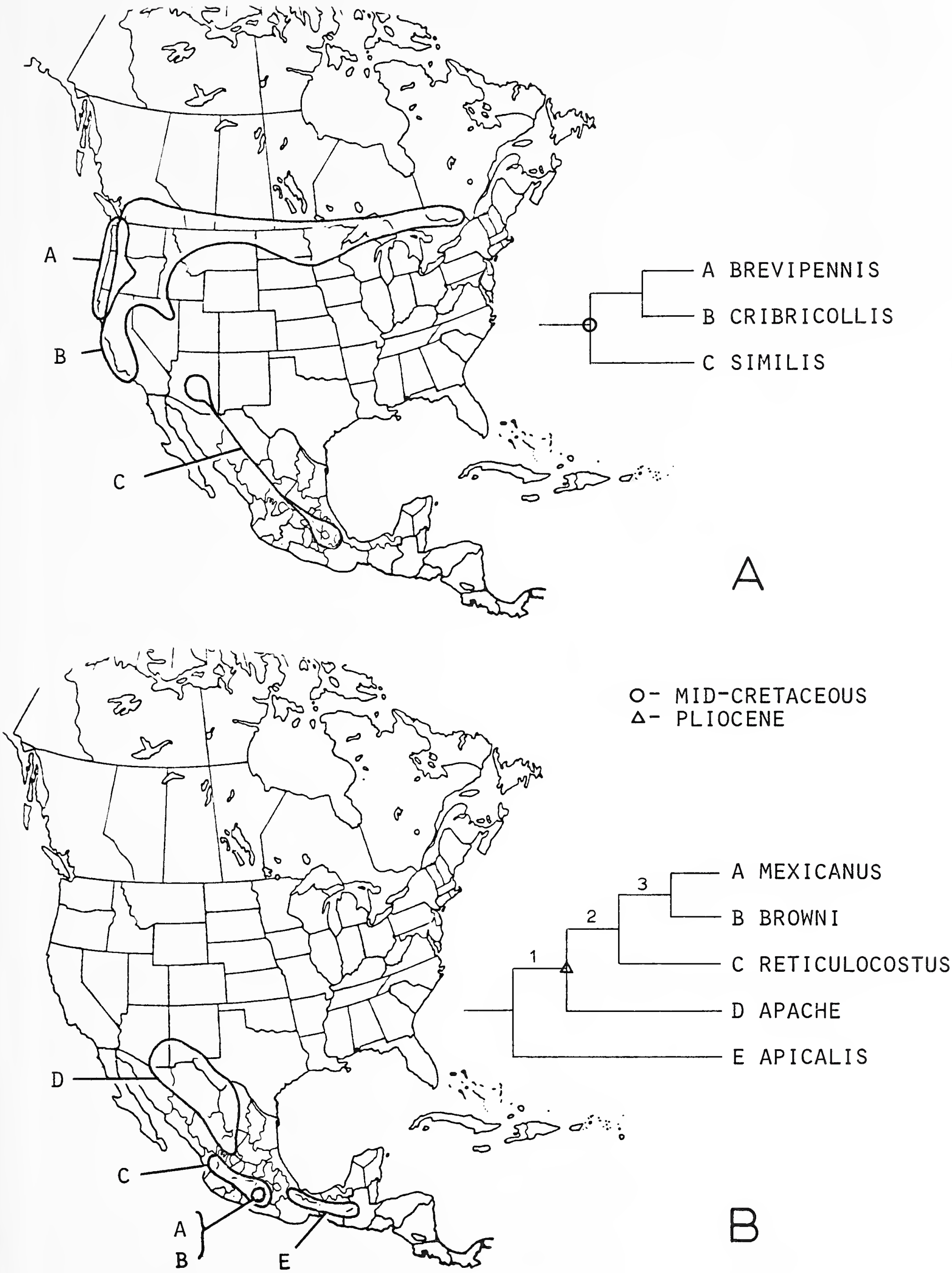
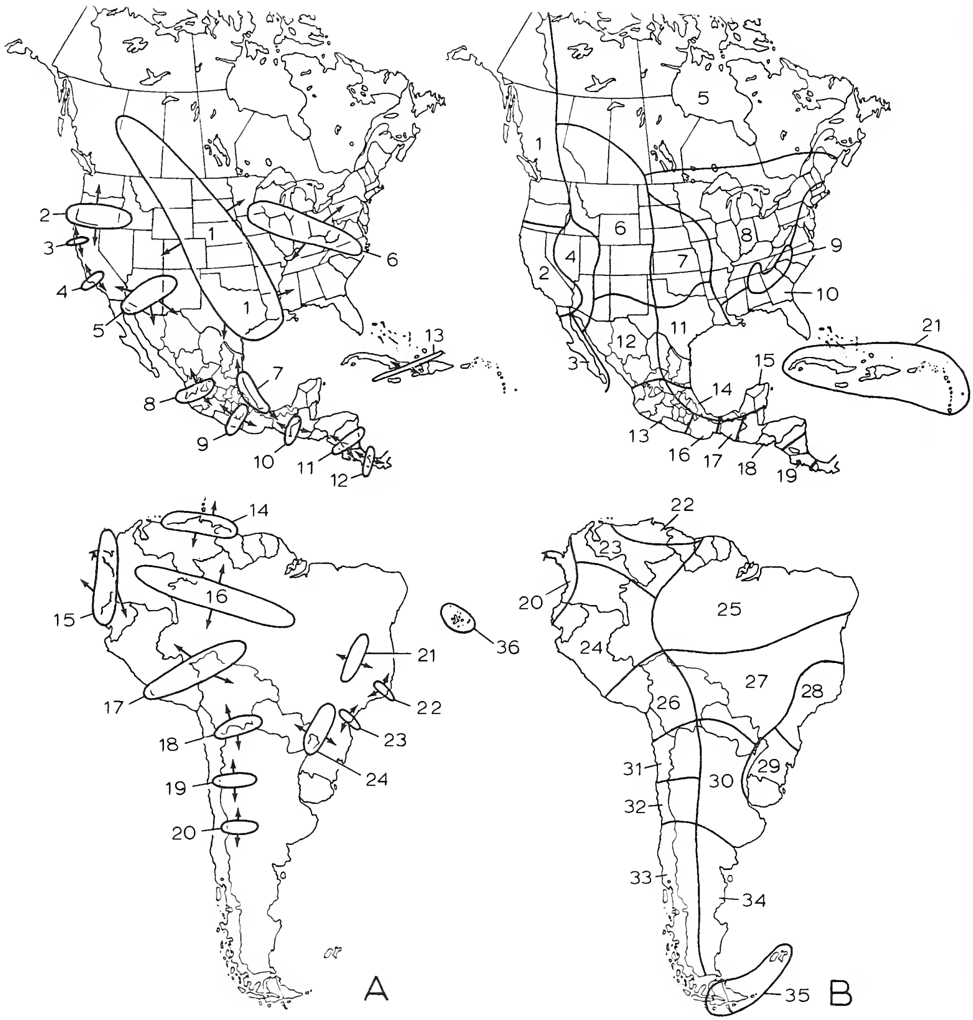


Fig. 187A-B. (A) Generalized geographical distributions and proposed phylogeny of the *similis* and *cribricollis* Subgroups of *O.* (*Asiobates*). (B) Generalized geographical distributions and proposed phylogeny of the *reticulocostus* Subgroup of *O.* (*Asiobates*).



Figs. 188A-B. (A) Vicariance Zones of Western Hemisphere *Hydraenidae* (arrows indicate location of sister-groups). (B) Zones of endemism.

illustrates this with examples of freshwater fishes, salamanders, snakes, an owl, a squirrel, and mesophytic trees and shrubs. Platnick (1976) suggests the Epicontinental Seaway acted as a vicariant event for the Holarctic spider genus *Callilepis*, and that it serves as an explanation for distributions of monophyletic groups with species in North America, Europe and Asia. Cox (1974) states that the Epicontinental Seaway and Turgai Straits acted together to divide Laurasia into two land areas with distinct dinosaur faunas: "Asiamerica" (Asia plus western North America) and "Euramerica" (Europe plus eastern North America) (see also Platnick, 1976).

This vicariance zone is suggested by eight different dichotomies in four genera of hydraenid beetles (see above), including both temperate and tropical groups.

Although the location of this vicariance zone corresponds to that of the Epicontinental Seaway, I do not dismiss the possibility that Pleistocene glaciation and this zone may be causually related. Some northern species of *Hydraena* might very well be candidates for Pleistocene–induced speciation. Stocks of the *circulata* Group of *Hydraena* probably existed as two monophyletic lineages across North America (more precisely, what was to become North America) before flooding formed the Epicontinental Seaway. The seaway then probably divided each group to form the ancestors of the four Complexes existing today (Figure 163C - note that the most recent dichotomies have an eastern and a western component). What leads me to suspect that Pleistocene glaciations are involved in more recent dichotomies is the fact that two eastern groups (*angulicollis* and *pennsylvanica* Complexes - Figures 164B, 165B) and one western group (*atlantica* Complex - Figure 165A) each have one or two species in the opposite area. Therefore it seems reasonable that preceding the Pleistocene the ancestor of *H. nigra–angulicollis–appalachicola* (Fig. 164B) dispersed westward and that concurrently the ancestor of *H. pacifica–atlantica* (Figure 165A) dispersed eastward. Likewise, westward range expansion of the *pennsylvanica* Complex stem species (Figure 165B) probably occurred. Pleistocene glaciation then split these stem species to form the following sister-groups: *H. pacifica* (western) and *H. atlantica* (eastern); *H. nigra* (western) and *H. angulicollis–appalachicola* (eastern); *H. vandykei–sierra* (western) and *H. pennsylvanica–ancylis* (eastern). Dispersal abilities/propensities of extant species in these groups are illustrated by *H. pennsylvanica* (Figure 165B) and, especially, *H. angulicollis* (Figure 164B), which now inhabit previously glaciated regions.

The genus *Limnebius* would appear to be another example where Pleistocene glaciation more adequately explains the synvicariads of Vicariance Zone 1. Western Hemisphere species of this genus occupy three geographical areas (Fig. 175): far western (five species) and eastern (three species) North America, and Central America (eight species). The reconstructed phylogeny indicates that eastern species have their sister-groups among the western North American component, not the Central American component. Therefore the major dichotomy of the genus does not correspond to Vicariance Zone 1, but to Vicariance Zone 5 (see below for a discussion of that zone).

Is it likely that *Limnebius* spread northward from Central America? I doubt this since the genus is primarily temperate, displaying a Laurasian distribution pattern (absent from South America and Australia).

I surmise, consequently, that sometime after recession of the Epicontinental Seaway, two western species spread across North America and their ranges were subsequently divided by Pleistocene glaciation to form the western-eastern sister-group relationships now seen.

If one is to disagree with this hypothesis and claim that eastern species result from the

Epicontinental Seaway, then Vicariance Zone 5 must be thought to antedate the Epicontinental Seaway or the phylogeny as proposed thought incorrect (or both).

For example, one could postulate a single wide-spread ancestral species (found in portions of western, eastern and southern areas of the present day range of the genus) which was vicariated sequentially by the Epicontinental Seaway (to form an eastern and a western-southern sister-group relationship), and by a vicariant event in vicariance zone 5 (to form the western and southern sister-groups). If this sequence of events is correct, however, not only the major dichotomy of the proposed phylogeny must be spurious, but also the sister-group relationships of the eastern species.

If one were to accept the phylogeny as proposed, while maintaining that eastern species were causally related to the Epicontinental Seaway, then Vicariance Zone 5 must be assumed to have preceded the seaway. Further, *two* stem species (each with ranges spanning Vicariance Zone 1) must be postulated to result in the sister-group relationships proposed for eastern species.

In partial summary, it appears that temperate sister-groups of Vicariance Zone 1 may be due either to the Epicontinental Seaway or Pleistocene glaciation, but the much older vicariant event is reflected (in reconstructed phylogenies) at the species complex level (at least in temperate *Hydraena*), whereas the recent vicariant event is reflected in species-level dichotomies (at least for temperate *Hydraena* and *Limnebius*).

Contrastingly, however, components of primarily *tropical* hydraenid lineages with sister-group elements on either side of Vicariance Zone 1 appear to be causually related to the Epicontinental Seaway at the sister-species or sister-species pair level.

Rosen (1975, 1978) has shown that sister-groups of several types of organisms have one component in the eastern United States, and the other in northeastern Mexico (i.e., on either side of the southern end of Vicariance Zone 1, Fig. 188A). Sister-groups of two tropical lineages of *Hydraena* also display this pattern (Figs. 167, 172B). These two synvicariads differ in that one involves primarily montane species whereas the other is composed of lowland coastal species. The montane species-group (Fig. 167) consists of the sister-species *H. ozarkensis* (Ozark Plateau) and *H. maureenae* (Appalachians), plus the sister-species *H. exilipes–H. campbelli* (highlands of eastern and southern Mexico). The lowland coastal species-group (Fig. 172B) is *H. marginicollis* in southeastern United States and *H. pulsatrix–H. longicollis* in eastern Mexico and Guatemala.

Two other examples of tropical synvicariads of Vicariance Zone 1 are seen in the genus *Gymnochthebius*. As discussed elsewhere herein, *Gymnochthebius* is a Gondwanian genus with less derived species in temperate South America and more derived species in Central and North America (the genus is also in Australia). Sister-species of *Gymnochthebius* which could be considered zone 1 synvicariads are *G. nitidus–G. falli* (Fig. 179) and *G. oppositus–G. seminole* (Fig. 94A – *seminole* is known only from Everglades, Florida). Both of these dichotomies could be considered causally related to the Epicontinental Seaway and therefore dating from the mid-Cretaceous.

In short, it appears that Vicariance Zone 1 is a result of both mid-Cretaceous (Epicontinental Seaway) and Pleistocene (glaciation) geologic events. Within the temperate *circulata* Group of *Hydraena* the much older geologic event (Epicontinental Seaway - ca. 100 million year ago) is reflected in dichotomies at the species complex level, whereas the very recent geologic event (Pleistocene glaciations - ca. 0.6 million years ago) is reflected in some species level dichotomies. Likewise, some sister-species and species-groups of temperate

Limnebius appear more likely a result of Pleistocene glaciations than Paleocene flooding. Nearctic components of primarily tropical lineages, however (e.g., *marginicollis* and *leechi* Groups of *Hydraena*, and *nitidus* Group of *Gymnochthebius*), which are found in eastern North America frequently display dichotomies which are probably causually related to the Epicontinental Seaway.

A vicariance zone, especially one as extensive in size and latitudinal coverage as Vicariance Zone 1, can therefore be a composite of vicariance events and reflect different dichotomy levels in reconstructed phylogenies of different groups.

Vicariance Zone 2. – This zone in western North America (Fig. 188A) coincides in general location to the "Basaltic Plateau" formed by giant lava flows which began during the Oligocene and continued locally into Pleistocene times. These lava flows spread out rapidly over large areas, exceeding 300,000 square kilometers, and filling in valleys (Dott and Batten, 1976). It seems safe to assume that these extensive lava flows would have extirpated any organisms in that region (certainly hydraenid beetles), and that resulting disjunction of biological ranges would have been of lengthy duration.

Five sister-groups of hydraenid beetles support this region as a vicariance zone, including two in the *circulata* Group of *Hydraena* (Fig. 164A), one in *Limnebius* (Fig. 175) and two in *Ochthebius* (Figs. 181A, 183). Post-vicariance dispersal partially obscures patterns in some of these examples. Dichotomies causually related to the Basaltic Plateau vicariant event would date to late Oligocene or Miocene, perhaps about 20-25 million years ago.

As an addendum to discussion of Zone 2, I wish to point out the high degree of sympatry displayed by species of the *discretus* Subgroup of *Ochthebius* in zone 2 (Fig. 186). If one were to accept the notion that "vicariance underlies and antedates nearly all cases of sympatric distributions" (Croizat et al., 1974:278), then certainly this lineage could be added to the list of synvicariads for zone 2. Also, does it possibly betray an error in the proposed phylogeny?

Vicariance Zones 3 and 4. – These zones amongst the California Coast Ranges may well relate to Miocene marine flooding of the California region. During this time the coast range basins "suffered remarkable 'see-saw' tectonics - that is, areas depressed in one epoch to receive thick sediments were upheaved to form ranges in another epoch of time" (Dott and Batten, 1976). Only one hydraenid sister-group relationship is known for each of these zones, which, in light of the high hydraenid density in California (discussed below) must mean that California has been an active area of post-vicariance dispersal for many species.

Vicariance Zone 3 is indicated by the sister-species *Hydraena californica–petila* (Fig. 165A), members of a primarily northern lineage. Zone 4 is derived from the sister-group *Ochthebius biincisus–(gruwelli+arizonicus)* (Fig. 180), members of a lineage which has its greatest diversity in Mexico.

Vicariance Zone 5. – This zone is suggested by six sister-group relationships, one in *Limnebius* (Fig. 175) and five in *Ochthebius* (Figs. 180, 185A,B, 187A).

Generally speaking, this zone equates to portions of the present arid region of the southwestern United States. Synvicariads of this zone have their northern components in the coastal ranges of California or, rarely, in northern Arizona (but apparently *not* the Rocky Mountains) southern components are in the Sierra Madre Occidental (including mountains of southeastern Arizona) or, rarely, the Rio Grande drainage basin.

What paleogeological events could account for this vicariance zone? Data suggest that two, and possibly three major geological changes have occurred in this region, including a mid-Cretaceous, a late Cenozoic and a Pleistocene event.

Dott and Batten (1976:358) depict this region (and areas to the south) as inundated with sea water during mid-Cretaceous. Rosen (1978:171) illustrates the entire region as exposed during "Cretaceous-Pleistocene" times, and depicts the western margin of the Epicontinental Seaway ("Cannonball Seaway") as east of Vicariance Zone 5 (i.e., passing through what is now Texas, but not extending westward into present Arizona). Dott and Batten (1976:357), however, depict mid-Cretaceous sediments of zone 5 as contiguous with those of the Epicontinental Seaway, consisting of shale and carbonate rocks. Based on this latter evidence, it seems highly likely that Vicariance Zone 5 was flooded with sea water from the Epicontinental Seaway.

For this flooding to act as a vicariant event, however, exposed land must have existed northwest (i.e., present California) and south (i.e., southern Arizona or northern Mexico) of this region. Dott and Batten (1976:355) state that during late Jurassic times (i.e., long before mid-Cretaceous flooding) "lands were beginning to be raised in the Cordillera, especially in western Arizona", and with respect to the western coastal regions: "The culminating Cordilleran Orogeny spanned Late Jurassic through early Cenozoic time" (p. 355) and "Along the western margin of the Cordilleran tectonic land, the Cretaceous shoreline oscillated somewhat, but effects were less pronounced than on the cratonic side. The western coastline was steeper..." (p. 362).

It therefore appears likely that, at a time just prior to flooding of Vicariance Zone 5 by the Epicontinental Seaway, a species could have ranged from the western montane region, through zone 5 and southward into montane regions of southern Arizona and northern Mexico.

A second geological upheaval occurred in the region of Vicariance Zone 5 during the Late Cenozoic (about 80 million years after the Epicontinental Seaway - 20 MYBP). During that time structural changes disrupted drainage systems and caused tremendous volcanic activity, including extensive lava flows. According to Dott and Batten (1976:389), "Renewed structural disturbances began in middle Cenozoic time in the central Cordilleral region, as in the Rocky Mountains, and have continued to the present. But here they were much more severe, involving chiefly block faulting. In Nevada, southeastern California, western Utah, southern Arizona, and adjacent Mexico, parallel northerly trending faults produced alternating narrow ranges and valleys... Faulting provided paths of escape of magma from the bowels of the crust and mantle. Flows spread over downfaulted valleys and lapped against ranges. Erosion of ranges produced sediments that also were dumped into the valleys. Renewed faulting offset the lavas and sediments, and new volcanic outpourings then burried older, faulted rocks".

Such monstrous Miocene volcanic activity probably could have acted as a vicariant event for hydraenid beetles.

A third possible geological vicariant event in Vicariance Zone 5 might have occurred during Pleistocene times as the arid zone begun in the Miocene increased in size until at maximum glacial advance it extended over much of California, Nevada, Utah and southern Idaho in the United States, and south to the volcanic plateau in Mexico. "Striking shifts of plant communities in arid southwestern United States and Mexico (begun in the Miocene) continued into Pleistocene time" (Dott and Batten, 1976).

The effect of Pleistocene drying upon aquatic organisms with rather limited dispersal capabilities such as hydraenid beetles may have been principally to "reinforce" disjunction already formed by Miocene volcanics. However, if hydraenid species extended their ranges into (and through) zone 5 after the violent Miocene volcanics, say perhaps in mid-Pliocene, they may have undergone disjunction as a result of Pleistocene hot, dry climatic conditions.

I suspect that Pleistocene–induced disjunctions had very little effect on hydraenid

sister-group relationships for the following reasons. First, recent studies (e.g., Coope, 1967; Ashworth, 1973a) have shown that periods of glacial recession were quite frequent during the Pleistocene, and that entire beetle faunal assemblages were able to follow the "ebb and flow" of ice sheets. Secondly, many hydraenid species now inhabit the arid southwest, in regions which have adequate physical relief to form permanent streams. It seems likely to me that runnoff from ice caps on mountains in zone 5 would have produced adequate streams to support most hydraenid species adapted for arid habitats, and that these species followed the ebb and flow of the ice caps much as did beetle faunal assemblages near glaciated regions of the northern United States and Europe. Pleistocene effects on species in Vicariance Zone 5 were, therefore, probably much less pronounced than those resulting from Miocene volcanics or mid-Cretaceous flooding.

The decision must now be made as to which of the three postulated vicariant events are causually related to which hydraenid dichotomies. Of the six sister-groups which show disjunctions in zone 5, three are major dichotomies of their respective lineages, three represent more "apical" dichotomies of their respective lineages, and all involve two Laurasian genera.

Interestingly, only one lineage displays two phylogenetically distant dichotomies as related to Vicariance Zone 5 (*Limnebius*, the first dichotomy of the genus plus that of *L. texanus*–(*richmondi*+*borealis*+*arenicolus*), Fig. 175), and only one lineage shows notable sympatry in zone 5 (the *biincisus* Group of *Ochthebius*, Fig. 180).

Although the following is more arbitrary than one might wish, based upon the "basal" nature of three dichotomies, they are tentatively placed at a mid-Cretaceous origin (vicariant event=Epicontinental Seaway). These dichotomies include: *Limnebius*, the first dichotomy (Fig. 175); *Ochthebius, discretus* Subgroup–*reticulocostus* Subgroup, and *cribricollis* Subgroup–*similis* Subgroup (Figs. 185B, 186, 187A,B).

The three "apical" dichotomies are placed at a more recent, Miocene origin (vicariant event=volcanics). These dichotomies include: *Limnebius*, sister-group *L. texanus*–(*richmondi*+*borealis*+*arenicolus*) (Fig. 175); *Ochthebius*, sister-species *O. puncticollis–angularidus* (Fig. 185A), and sister-group *O. mexcavatus* –(*gruwelli*+*arizonicus*+*biincisus*) (Fig. 180). Only one dichotomy, not yet discussed, is tentatively attributed to Pleistocene aridity: *Ochthebius gruwelli–arizonicus* (Fig. 180).

Vicariance Zone 6. – This zone in eastern North America is supported by three synvicariads in the genus *Hydraena*, one of temperate and two of tropical lineage. The limits of this zone are not clearly defined. Synvicariads of tropical lineage include a montane and a lowland coastal sister-species pair; the montane pair with one species in the Ozarks and its sister-species in the Appalachians (*H. ozarkensis–maureenae*, Fig. 167); the lowland coastal pair with one species widely distributed from Texas to Florida and north to Maryland, and its sister-species restricted to New England states (*H. spangleri–punctata*, Fig. 168). The third sister-species pair are members of the temperate *circulata* Group of *Hydraena* (*H. pennsylvanica–ancylis*, Fig. 165B).

At present I am unable to definitely associate this vicariance zone with a paleogeological event, but suspect it relates to Pleistocene glaciation, for the temperate *H. pennsylvanica–ancylis* sister-species pair at least. As indicated for other vicariance zones, zone 6 may be a composite of paleogeological events. Dichotomies of the tropical lineages may be due to early geological events in this region, or to Pleistocene glaciation.

Vicariance Zone 7. – This zone along the gulf coast of Mexico is derived from two sister-species pairs of tropical *Hydraena* lineages (*H. exilipes–campbelli*, Fig. 167; *H.*

pulsatrix–longicollis, Fig. 172B). Rosen (1978) has very nicely documented examples of sister-groups which show geographical disjunction in this region, including fresh water fish and various plants. Rosen (1978:171) depicts this geographical region as being flooded during mid-Cretaceous times, a position I believe is corroborated by these two hydraenid sister-groups.

Vicariance Zone 8. – This zone corresponds closely in geographical location to a belt of volcanism which extended across Mexico during Plio–Pleistocene times (Rosen, 1978:171; Dott and Batten, 1976:430). Hydraenid synvicariads of this zone include two in *Spanglerina* and one each in *Hydraena* and *Ochthebius*. They are: *S. brevis–frondsicola* and *S. ingens– fluvicola* (Fig. 174); *H. argutipes–prieto* (Fig. 169); and *O. apache*–(sister-group) (Fig. 187B). These dichotomies are therefore postulated to have occurred during Pliocene times.

Vicariance Zone 13. – This zone (between Cuba and Haiti–Dominican Republic) is suggested by one sister-group of *Hydraena*, *H. perkinsi–haitensis* (Fig. 170). However, more complicated patterns of distribution in this region are seen in the *particeps* Subgroup of *Hydraena* (Fig. 168). These sister-group patterns have been discussed earlier in the section on that Subgroup; they may relate to Rosen's (1975) vicariance model of Caribbean biogeography.

Endemism

As a conclusion to this preliminary study of hydraenid zoogeography, I have divided the Western Hemisphere into geographical regions (Fig. 188B) and compiled, for each region, (1) the total number of species and (2) the number restricted to that region (i.e., endemics). Region 2 for example, which consists almost entirely of California, has 45 hydraenid species, 17 of which are restricted to that region.

The primary goal in delineating these regions is to identify and contrast areas high in endemics from those with depauperate faunas. Most of the boundaries selected coincide with vicariance zones (cf. Figs. 188A,B), which is not mysterious since vicariance zones are measures of sister-group allopatry as are zones of endemism. Some of these areas correspond generally to geological regions, such as the Great Basin (4), Rocky Mountains (6) and Great Plains (7); others, such as the Antilles (21) may be more arbitrary.

The number of species per region are as follows (endemics/total):

1 (1/28). 2 (17/45). 3 (0/4). 4 (0/10). 5 (0/5).
6 (3/26). 7 (0/5). 8 (3/19). 9 (0/1). 10 (2/14).
11 (3/12). 12 (12/24). 13 (14/22). 14 (0/4). 15 (0/3).
16 (6/13). 17 (5/16). 18 (3/14). 19 (4/10). 20 (3/6).
21 (5/9). 22 (1/4). 23 (1/7). 24 (8/9). 25 (0/3).
26 (1/1). 27 (3/5). 28 (14/14). 29 (1/1). 30 (1/3).
31 (2/3). 32 (1/1). 33 (7/7). 34 (0/0). 35 (1/1).
36 (1/1).

Since most hydraenid species live in montane streams, it is not unexpected that montane geographical regions 2 (California-45 species, 17 endemic) and 6 (Rocky Mountains-29 species, 3 endemic) have more species than arid, flat areas such as regions 4 (Great Basin-10 species, no endemics) and 7 (Great Plains-5 species, no endemics). Why, however, do species totals and endemism percentages differ greatly between montane regions 2 (45 species, 38% endemic) and 6 (29 species, 12% endemic)?

The number of species in each geographical region is a product of the number of vicariant events within and at the borders of that region, plus the extent of dispersal into that region. Dispersal in turn is dependent upon vagility and habitat availability (the latter including

competition factors). For a given geographical region, the percentage of endemics is higher when border vicariance zones are not crossed by synvicariads, and lower when post-vicariance is common.

As Fig. 188A shows, California has been a region of extensive, *demonstrable* vicariance activity. The Rocky Mountains, however, show fewer vicariant events (only one in hydraenids, but other vicariant events probably occurred and have been subsequently obscured by dispersal). Additionally, dispersal east and south from (and into) California has been greatly curtailed by desert conditions since the Miocene, which results in a higher percentage of endemism. However, post-Miocene dispersal of California species northward into the Rocky Mountains of British Columbia, and then southward in the Rockies has been rather commonplace, as has dispersal in the opposite direction by Rocky Mountain species (see Figs. 164A,B, 165A, 175, 186).

EPILOGUE

In this paper I have attempted to elucidate, as clearly as possible, the individual building blocks of hydraenid systematic studies: species taxa. I have also attempted to define the major evolutionary lines of the family, based upon synapotypic character states. These tasks remain, however, far from complete.

Phylogenetic relationships of the most dissimilar genera are now fairly well established. However, this reconstructed phylogeny is only a preliminary framework to be tested and built upon as new genera, most likely South African and Australian, are discovered and described. Some of the putative synapotypic character states I have used, especially those of the larvae, are based only on simple similarity. Much work remains to establish, particularly by out-group comparisons, morphocline polarities and to differentiate apotypic from plesiotypic character states.

Especially within the species-complex do we find difficulty in supporting suggested phylogenies. Many of the sister-species pairs proposed herein are based upon aedeagal similarity. Certainly some of these species have been correctly paired, and we can credit the complex male genitalia for this small success. But again, certainly some of these putative pairs are incorrect, and errors in the phylogenies lead to more of the same in the biogeographical analysis, since correct historical biogeography is contingent upon strict monophyly.

Cladistics and vicariance methods rely entirely upon adequate material, the field-work foundation of all systematic studies. Much specialized collecting remains to be done in Central and especially South America. Certainly there are many undiscovered forms in the neotropics which, when carefully studied, will modify the reconstructed phylogenies and distributions, and alter the very preliminary vicariance zones which are indicated by specimens presently available.

We cannot know for certain the percentage of error in the reconstructed, species-level phylogenies, but the repetitiveness of sister-group patterns does suggest some degree of correctness, that is if vicariance theory is accepted. That is to say, repetitiveness of disjunction areas between sister-groups is what one would *expect* to find if reconstructed phylogenies are correct.

Of course we must avoid the circular argument of using vicariance theory to explain sister-group distributions and concurrently using coincident sister-group patterns as evidence that vicariance has occurred. In this work the reconstructed phylogenies are based solely upon

morphology. Only after the phylogenies were reconstructed did I search for sister-group coincidence. Finally, as a last step, I searched the literature for paleogeological events to correlate with these geographical areas of sister-group disjunction. To my pleasant surprise, in nearly every instance, the "vicariance zones" established for hydraenids in North America and northern Central America had a geographical coincidence with a major paleogeological event, either flooding, volcanism or glaciation. Now, in retrospect, I have more confidence in the phylogenies than had I not used them in a biogeographic analysis.

APPENDIX A: PARATYPES AND SPECIMENS EXAMINED

(Depository abbreviations in parentheses are accompanied by the number of specimens studied. When two numerical entries are given, separated by a diagonal line, males are represented by the first entry, females by the second. Genera are given in this sequence: *Parhydraenida*, *Hydraena*, *Limnebius*, *Gymnochthebius*, *Ochthebius*, and *Neochthebius*. Dates are given in a year–month–day sequence. Species which have all of their locality data cited in the text are not included in this appendix).

1. *Parhydraenida reichardti* J. Balfour-Browne

Map: Figure 14B
Specimens examined: 16

Brazil: Espirito Santo: 18 km E. Itabita, 900 m (km 138, Br 262), 75-02-07, H. & B. Reichardt (0/1 MSP). Rio de Janeiro: Teresopolis, km. 17, 1180 m., hygropetric habitat, 77-04-19, S. Vanin & O. Flint (2/1 MSP; 1/0 USNM; 1/1 PDP). Santa Catarina: Blumenau, cascata-Estrada, junto Rio Garcia, 75-12-02, Froehlich & Vanin (2/1 MSP; 1/0 USNM; 1/0 PDP). Sao Paulo: Salesopolis, Reserva Casa Grande (Pedreira), hygropetric habitat, 77-10-03, Froehlich & Chapon (1/0 MSP). Sao Sabastiao, 15 km. S., 71-10-03, H. & B. Reichardt (1 MSP). Salesopolis, Est. Biol. Boraceia, 71-09-24, H. & B. Reichardt (1 MSP).

1. *Hydraena circulata* new species

Map: Figure 23A
Paratypes: 790

Canada: Alberta: Edmonton, 20-05-19, F.S. Carr (0/1 MCZ). British Columbia: Victoria, Vancouver Is., no date, Wickham (0/1 USNM). Cariboo Dist., Beedy Creek at Gaston Ranch, 30 mi. NE McLeese Lake, 71-07-25, P.D. Perkins (1/6 PDP). Fraser Valley, no date, no collr. (0/1 USNM). Ashcroft Manor, irrigation ditch, 40-05-30, H.B. Leech (0/2 CAS). Tappen, White Lake Creek, 33-10-09, H.B. Leech (5/12 CAS). Summerland, 32-06-09, A.N. Gartrell (1/0 CNC). Kitchener, Goat River, 51-08-26, G. Stace Smith (9/6 UBC). As above, 55-09-04 (0/2 UBC). Sanca, Sanca Creek, 33-04-23, G. Stace Smith (1/0 UBC). 20 mi. W. Rossland, bog, 69-09-23, J. Schuh (0/1 JS). Fraser Valley, no date, no collr. (1/0 USNM). Peachland, 15-08-23, J.B. Wallis (0/1 CNC). Kamloops, Lac du Bois swamp, no date, H.B. Leech (1/1 CAS). Jaffray, Little Sand Cr., 50-07-23, H.B. Leech (0/1 CAS). Lumby, 37-09-19, H.B. Leech (0/2 CAS). Terrace, no date, M.E. Hippisley (0/1 CAS). Edgewood, Inonoaklin River, 46-09-29, S.H. Farris (0/1 CAS).

Mexico: Baja California: La Suerte, Sierra San Pedro Martir, pool in canyon, 3700', 63-06-04, R.K. Benjamin (0/1 CAS).

United States: Arizona: Cochise Co.: Upper Carr Cyn., Huachuca Mts., 7500', 52-08-06, H.B. Leech (0/1 CAS). Sunnyside Cyn., W. side Huachuca Mts., 52-08-04, H.B. Leech (0/1 CAS). Chiricahua Mts., above Herb Martyr, 74-06-22, Harley P. Brown (1/0 HPB). Coconino Co.: Oak Cr. Canyon Midgley Bridge, 52-07-25, H.B. Leech (1/0 CAS). Pima Co.: Santa Catalina Mts., 46-06-01, Bryant (0/1 CAS). S. Catalina Mts., 5000' no date, no collr. (1/1 CU). Pinal Co.: Riverside no date, Wickham (0/1 USNM; 1/0 CAS). Santa Cruz Co.: Madera Cyn., Santa Rita Mts., 52-08-01, H.B. Leech (4/3 CAS). Yavapai Co.: Brush Cyn., Bloody Basin, 74-06-19, H.P. Brown (1/0 HPB). California: Alameda Co.: Dublin, 47-07-20, P. Giuliani (0/1 CAS). Dimond, 60-05-15, F.E. Blaisdell (0/2 CAS). Butte Co.: 1 mi. E. Paradise, 1650', 70-11-26, P.D. Perkins (1/1 PDP). Little Chico Creek at School Rd., E. of Forest Ranch, Alt. 2300', 61-09-01, H.B. Leech (15/12 CAS). French Creek, 49-06-23, H.P. Chandler (3/0 CAS). Calaveras Co.: 4.5 mi. W. Altaville, Waterman Cr., 63-08-31, H.B. Leech (0/1 CAS). Murphys, 2500', 36-05-19, F.E. Blaisdell (1/0 CAS). Mokelumne Hill, 07-08-06, F.E. Blaisdell (0/3 CAS). Contra Costa Co.: Perkins Gulch, 7 mi. SE Clayton, 66-07-22, J.

Doyen (2/1 UCB). El Dorado Co.: Strawberry Valley, 03-09-01, no collr. (0/3 CAS). Rubicon River at Georgetown-Ralston Rd., 63-07-27, H.B. Leech (0/1 CAS). 2 mi. SSE Quintette, tributary, Whaler Creek, 63-07-27, H.B. Leech (4/3 CAS). Fresno Co.: Fresno, no date, E.A. Schwarz (0/1 USNM). Fresno, no date, H.T. Scott (2/2 LACM). Fresno, 33-06-01, R. Wagner (38/40 UCD). Taenio, no date, no collr. (1/2 UCB). Stream from E. entering S. Fr. San Joaquin R. at gauging station by N. end Jackass Dike, N. of Florence Lake, 7200', 71-08-31, H.B. Leech (14/7 CAS). Fresno, no date, R. Wagner (2/2 CAS). Humboldt Co.: Mad R. at Kneeland-Addison road, 66-08-09, H.B. Leech (0/1 CAS). Hydesville, no date, no collr. (1/0 CAS). 0.8 mi. W. Butte Cr., pool in drying up stream under Route 36, Larabee Valley, Alt. 2470', 68-07-19, H.B. Leech (0/2 CAS). Inyo Co.: Bartlett Sprs., no date, no collr. (0/1 MCZ). Kern Co.: Cedar Cr., just above Alder Cr. campground, Greenhorn Mts., 4000', 70-03-24, H.B. Leech (0/1 CAS). Alder Creek, Alder Creek Campground, 4000', W. side Greenhorn Mts., 70-03-24, H.B. Leech (2/0 CAS). Lake Co.: L. Blue Lake, 47-08-11, 1500', 47-08-11, H.P. Chandler (0/1 CAS). Bartlett Creek, Bartlett Springs, 55-080-1, H.B. Leech (0/1 CAS). Lucerne, fool pool, dried bed of Cottage City creek, 55-08-30, H.B. Leech (0/1 CAS). 6.9 mi. N. Middletown on Hway. 29, puddle in grassy slope, R.A. Badger Ranch, 55-02-07, J.R. Helfer (14.3 CAS). 6.9 mi. N. Middletown on Hway 29, R.A. Badger Ranch, ephemeral stream, 55-02-20, H.B. Leech (0/3 CAS). Los Angeles Co.: Pasadena, 18-11-02, J.O. Martin (1/0 Cas). Los Angeles, no date, A. Koebele (0/2 USNM). Mts. nr. Claremont, no date, no collr. (1/0 CMP). Chatsworth Cyn., 20-04-03, L.L. Muchmore (2/4 LACM). Los Angeles, no date, Hubbard and Schwarz (1/0 USNM). Los Angeles, no date, no collr. (1/0 USNM). Pasadena, 18-02-09, J.O. Martin (0/1 CAS). No site, no date, no collr. (1/0 USNM). Madera Co.: Boggy Mdws., 6000', 46-07-15, H.P. Chandler (0/1 CAS). Whiskey Creek, 4000', H. Dietrich (2/0 CU). Northfork, 29-03-19, H. Dietrich (1/0 CU). As above, 20-03-07, (7/7 CU). Sugar Pine, no date, A. Fenyes (0/12 CAS). Marin Co.: Lake Lagunitas, 19-04-01 (0/1 CAS). Novato, in stream bed, 52-06-17, H.B. Leech (0/1 CAS). No site, 19-11-08, H. Dietrich (1/0 CU). Mariposa Co.: Miami Range Sta., 5000', 42-07-06, H.P. Chandler (1/0 UCB). Sweetwater Creek, 46-07-24, H.P. Chandler (2/0 CAS). Mendocino Co.: Bear Pen Canyon Cr., just above junction with Burger Creek, Dos Rios-Laytonville rd., 72-08-30, H.B. Leech (0/3 CAS). Mill Cr. just W. of Mailliard Redwoods State Park, 64-09-06, H.B. Leech (0/1 CAS). Black Butte River just above mouth, 68-07-17, H.B. Leech (0/1 CAS). Mendocino, 54-07-17, J.R. Helfer (0/1 CAS). Jumpoff Cr., 53-08-14, P.S. Bartholomew (0/2 CAS). Eel River R.S., 53-08-14, P.S. Bartholomew (0/1 CAS). Williams Creek at Covelo-Paskenta Rd., 68-07-17, H.B. Leech (0/1 CAS). Bloody Run Creek, 7 mi. E. route 101 on Longvale-Covelo rd., 1100', 68-07-18, H.B. Leech (0/3 CAS). Mendocino, 57-07-21, J.R. Helfer (0/1 CAS). McDowell Cr., just below Oasis, 1800', 55-07-27, H.B. Leech (1/0 CAS). Modoc Co.: Rush Cr., 9 mi. N. Admin, 50-07-16, H.B. Leech (0/1 CAS). Mono Co.: Round pond on ridge S. of Leavitt Mdw., 63-08-13, H.B. Leech (0/1 CAS). Pond on ridge S. of Leavitt Mdw., 7500', 62-08-10, H.B. Leech (0/1 CAS). Leavitt Mdw., Ranunculus pool by West Walker River, 62-08-09, H.B. Leech (0/1 CAS). Monterey Co.: Escondido, 74-09-01, J.E. Cronin (1/0 JEC). As above, 73-05-19. (2/2 JEC). Jolon, 44-04-08, E. Ray (0/1 CFMNH). Lion Cr., 4.1 mi. NE jct. Hwy. 1 and Kirk Cr., 71-10-25, P.D. Perkins, (4/8 PDP). As above, 72-06-17 (8/5 PDP). The Indians, seepage trickle over gravelly soil, 2 mi. SE Santa Lucia Memorial Park, 56-01-15, H.B. Leech (7/0 CAS). As above, 56-01-16 (5/4 CAS). The Indians, seepage over rocks and small cliffs, 56-01-16, H.B. Leech (5/11 CAS). Junipero Serra Pk., Santa Lucia Mts., Forestry Camp spring, ca 4900', 56-08-12, H.B. Leech (8/3 CAS). Pleyto Rd. at San Antonio River, 63-04-09, D.C. Rentz and K.A. Hale (1/0 CAS). Monterey, 16-06-24, J.O. Martin (0/1 CAS). Carmel, 14-06-27, L.S. Slevin (1/0 CAS). Napa Co.: Pope Cr. at Walter Sprs. road, 520', 64-08-24, H.B. Leech (0/1 CAS). Pope Cr. at Maxwell Creek, 64-05-10, H.B. Leech, (0/1 CAS). Calistoga, 34-06-13, Bryant (1/0 CAS). Nevado Co.: Graniteville, 70-07-01, D.S. Chandler (0/2 UA). Graniteville, 52-08-22, P.S. Bartholomew (3/0 CAS). Sagehen Cr., 70-07-27, D.S. Chandler (1/1 UA). As above, 70-07-22, (1/0 UA). Placer Co.: No site, no date, A. Koebele, (0/2 USNM). Lake Tahoe, 1879-05-24, no collr. (0/1 INHS). Plumas Co.: West Ridge, Portola, 53-05-10, P.S. Bartholomew, (0/1 CAS). Riverside Co.: San Jacinto Mts., no date, F. E. Winters, (0/2 CAS; 0/2 MCZ). Riverside, no date, F.E. Winters, (0/2 MCZ). San Jacinto Mts., no date, F.E. Winters, (14/5 CU). Sacramento Co.: Folsom, 1885-07-05, no collr. (0/1 USNM). San Bernardino Co.: Lake Arrowhead, 43-05-07, G.P. Mackenzie, (1/3 LACM; 1/0 UCR; 1/3 CAS; 1/2 UA). San Diego Co.: Poway, no date, F.C. Bowditch (1/1 MCZ). Nr. Warner Hot Sprs., 58-05-07, D. Giuliani (1/0 CAS). San Diego, no date, F.E. Blaisdell (0/1 CAS). San Francisco Co.: San Francisco, no date, D. Giuliani (0/1 CAS). San Luis Obispo Co.: Santa Lucia Range, 1800', 54-07-05, Bryant (1/2 CAS). San Mateo Co.: No site, no date, no collr. (2/3 CAS). San Barbara Co.: Santa Barbara, no date, F.E. Winters (4/11 CAS). Santa Cruz Island, no date, F.E. Winters (0/1 CAS). Santa Clara Co.: Guadelupe Creek, 74-06-01, J.E. Cronin (3/4 JEC). Sveadal, 71-05-04, J.E. Cronin (0/2 JEC). Sveadal, 68-04-27, A. and A. Gillogly (1/0 AG). 15 mi. N. Lick, Mt. Hamilton, 68-02-22, A. and A. Gillogly (6/13 AG; 1/0 UCR). 16.5 mi. N. Lick, Mt. Hamilton, 68-03-01, A. and A. Gillogly (0/9 AG). 14 mi. N. Lick, Mt. Hamilton, 68-03-01, A. and A. Gillogly (0/1 AG). 25.6 mi. N. Lick, Mt. Hamilton, 68-03-31, A. and A. Gillogly (1/0 AG). Stanford Univ., Los Trancos Creek, 51-02-09, P.S. Bartholomew (0/1 CAS). Gilroy, 15-06-07, no collr. (1/0 CAS). Santa Cruz Co.: Santa Cruz Mts., no date, A. Koebele (2/7 USNM; 1/0 CAS). Shasta Co.: 2.5 mi. W. and S. Viola Bailey Creek, 61-08-31, H.B. Leech (/3 CAS). Castle Crags St. Park, Silver Slipper Creek, 50-07-29, H.B. Leech (0/1 CAS). Sierra Co.: N. Fork Yuba River above Indian Valley, 61-08-26, H.B. Leech (1/2 CAS). Onion Cr., N. end Onion Valley, 6075', 64-10-21, H.B. Leech (2/0 CAS). Siskiyou Co.: N. Russian Creek at foot Jumpoff Joe curve, Etna road, 3640', 70-08-17, H.B. Leech (0/1 CAS). Shasta Retreat, no date, no collr. (1/0 CAS). No site, no date, A. Koebele (0/1 USNM). No site, no date, F.E. Blaisdell (1/0 CAS). Sonoma Co.: Cheney Cr. 2.8 mi. S. and E. of

Bodega Bay, 63-07-01, H.B. Leech (0/2 CAS). No site, no date, no collr. (0/1 CAS). Mark West Cr. at Calistoga rd., ca 4 mi. S. of Petrified Forest, 63-07-08, H.B. Leech (1/0 CAS). Stanislaus Co.: 16 mi. W. Patterson, Adobe Creek, 48-04-25, H.B. Leech (2/0 CAS). Tehama Co.: 1 mi. SW Government Camp, clear mountain stream, 6000', 60-07-29 (0/1 CAS). S. Fr. Battle Creek, 70-05-16, D.S. Chandler, (1/3 UA). As above, 70-08-09 (1/0 UA). 7.1 mi. W. Manton, S. Fk. Battle Creek, 61-08-31, H.B. Leech (7/5 CAS). Trinity Co.: Upper Mumbo Lake, NE corner Trinity Co., 6110', 68-08-04, H.B. Leech (0/2 CAS). Darlingtonia bog, Scott Mt. Pass, 5300', 66-08-18, H.B. Leech (0/1 CAS). Van Horn Cr. 1.5 mi. above its mouth at upper Mad river, 2850', clear water pools in gravel and stones of otherwise dry and shaded creek, 70-08-09, H.B. Leech (1/1 CAS). Mud Lake, road to Lake Eleanor trail, 1280 m, 72-08-10, H.B. Leech (0/1 CAS). Scott Mtn. summit campground, Callahan-Carville Road, pools, small stream in drying Darlingtonia bog by camp, 5403', 70-08-22, H.B. Leech (0/1 CAS). Tulare Co.: Kaweah, no date, Hopping (0/1 USNM). Sequoia N.P., no date, F. T. Scott (1/0 MZ). Kaweah, 44-09-20, no collr. (1/0 CAS). Marble Fork, 7000', no collr. (0/2 CAS). Potwisha, 2000'-5000', 31-07-16, no collr. (2/0 CAS). As above, 3000'-5000', 29-06-02, (6/6 CAS). As above, 7000'-9000', 29-06-20 (2/3 CAS). 3 km E. California Hot Springs, tributary to Capinero Creek, alt. 1219 m, 69-04-10, H.B. Leech (2/0 CAS). Kaweah, no date, R. Hopping (2/2 CAS). Tuolumne Co.: 1.5 mi. N. Pinecrest Lake, trib. to Herring Cr., 6000', ex seepage full of dead conifer leaves, 64-08-08, H.B. Leech (0/1 CAS). Pinecrest, 47-07-15, P.H. Arnaud, Jr. (1/0 CAS). Sonora, no date, H.P. Chandler (1/0 CAS). Colorado: Chaffee Co.: Buena Vista, no date, no collr. (0/1 MCZ). El Paso Co.: Colorado Springs, 6000'-7000', 1896-Fremont Co.: Coal Creek Canyon, 30-07-25, J.W. Green (5/4 CAS). Gunnison Co.: W. side of Monarch Pass, 36-07-29, no collr. (0/2 UCM). Routt Co.: Steamboat Springs, 6800', 41-10-01, Bryant (3/0 CAS). Unspecified Co.: No site, no date, C. Palm (3/1 AMNH). No site, no date, no collr. (2/4 INHS). Idaho: Adams Co.: 3 mi. W. New Meadows, Mud Creek, 56-07-20, H.B. Leech (2/0 CAS). Bingham Co.: No site, no date, Hubbard and Schwarz (0/2 USNM). Bonner Co.: Pack River, 50-07-19, H.B. Leech (0/2 CAS). 8 mi. N. Sandpoint, Pack River, 69-09-22, J. Schuh (0/4 JS). Montana: Blaine Co.: Bear Paw Mt., no date, Hubbard and Schwarz (5/3 USNM). El Paso Co.: Colorado Springs, no date, Hubbard and Schwarz (1/0 USNM). Lewis and Clark Co.: Helena, no date, Hubbard and Schwarz (2/1 USNM). Unspecified Co.: Assinbne, no date, Hubbard and Schwarz (2/0 USNM). New Mexico: Catron Co.: 4 mi. NE Glenwood, Whitewater Canyon, 52-08-20, H.B. Leech (1/0 CAS). Grant Co.: 6 mi. N. Pinos Altos, Cherry Cr. picnic grounds, 52-08-21, H.B. Leech (0/2 CAS). Sandoval Co.: Jemez Mts. no date, J. Woodgate (1/0 CAS). Jemez Sprs., no date, no collr. (1/2 CU; 6/15 AMNH). Sante Fe Co.: St. Fe. Canyon, no date, no collr. (1/1 CNC). Oregon: Baker Co.: Halfway, 68-07-06, J.L. Carr (3/0 JLC). Benton Co.: 9 mi N. Corvallis, 59-05-02, G. Kraft (1/1 USNM). Curry Co.: Pistol River, Meyers Cr., 38-05-18, H.B. Leech (0/1 CAS). Douglas Co.: 1.5 mi. E. Tiller, side hill rill, 66-05-31, J. Schuh (0/1 JS). Grant Co.: Pass Cr. N. of Long Cr., 50-07-18, H.B. Leech (1/0 CAS). Beech Cr., 5015', 50-07-17, H.B. Leech (0/1 CAS). Ritter Hot Springs, temp. 78-90°F., 62-04-05, K. Goeden (0/1 ODA). Hood River Co.: Hood River, no date, Hubbard and Schwarz (1/0 USNM). Jackson Co.: 8 mi. S. Hwy. 66 Copco Rd., ex. moss along creek, 61-05-20, J. Schuh (0/1 JS). Klamath Co.: Mare's Egg Spring, 62-05-30, J. Schuh (2/1 DCM). 8 mi. NE Bly, Deming Creek, 67-08-19, J. Schuh (1/4 JS). 11 mi. NE Bly, edge Deming Creek, 66-05-13, J. Schuh (2/1 JS). 15 mi. NE Bly, Deming Creek, J. Schuh (2/0 JS). 11 mi. NE Bly, Deming Creek, 69-09-16, J. Schuh (1/0 JS). 12 mi. NE Bly, Long Creek, 67-09-24, J. Schuh and E. Evans (0/2 JS). Denny Cr., 58-05-01, J. Schuh (0/1 JS). Upper Klamath Lake, along lake shore, 55-05-17, J. Schuh (0/1 JS). Klamath Falls, Barkley Springs, 55-06-01, J. Schuh (0/1 JS). 7 mi. NW Bly, Meryl Cr., 62-05-01, J. Schuh (0/1 JS). Lane Co.: 7mi. S. Florence, Siltcoos Bch., Vertrees, Hansen, Carter and Schuh, 62-05-01 (0/2 JS). 2 mi. N. Junction City, 72-02-12, L. Ryker (0/1 ORSU). Multnomah Co.: Portland, no date, Hubbard and Schwarz (0/1 USNM). Umatilla Co.: Fly Cr., 61-11-15, J. Schuh (0/2 JS). Blue Mts., 34-08-12, Bryant (0/1 CAS). Wheeler Co.: 10 mi. NNE Spray, NE Fk. Deadhorse Cr., 3178' 64-07-06, H.B. Leech (0/3 CAS). Utah: Garfield Co.: Canyon City, no date, Hubbard and Schwarz (0/2 USNM). Unitah Co.: Cub River Cyn., 56-12-04, G.F. Knowlton (2/3 OSU). Wasatch Co.: Provo River, 2 mi. below upper bridge, 48-06-01, G.K. Todd (0/1 INHS). Washington: Pierce Co.: Tacoma, no date, H.F. Wickhan (0/1 USNM). Whatcom Co.: Ross Lake, 71-07-22, P.D. Perkins (2/0 PDP). Wyoming: Lincoln Co.: Allred Flats Rec. Area, 6700', 62-06-24, C.W. O'Brien (0/1 UCB). Sheridan Co.: Bighorn Natl'l. Forest, Isaac Walton picnic area, nr. Dayton, 62-08-14, P. and P.J. Spangler (1/1 USNM).

2. *Hydraena arenicola* new species

Map: Figure 27D

Paratypes: 433

United States: California: Butte Co.: Little Chico Cr. at School Rd., E. of Forest Ranch, 2300', 61-09-01, H.B. Leech (1/0 CAS). Contra Costa Co.: Hills back of Oakland, 08-06-07, no collr. (1/2 cas). Berkeley, 19-11-11, H. Dietrich (1/2 CU). Humboldt Co.: Mad River at Kneeland-Addison Rd., 66-08-09, H.B. Leech (0/1 CAS). Frenchman Creek at Garberville-Alder Point Rd., 68-07-18, H.B. Leech (2/1 CAS). Larabee Valley, 0.8 mi. W. Butte Cr., pool in drying up stream under route 36, 2470', 68-07-19, H.B. Leech (4/0 CAS). Conley Creek, 0.8 mi. SE Blocksburg, 1350', 68-07-19, H.B. Leech (4/5 CAS). Burr Cr., 3 mi. S. of Bridgeville, 1200', 68-07-19, H. B. Leech (0/5 CAS). Martin Cr., 10 mi. S. of Bridgeville, 1150', 68-07-19, H.B. Leech (0/1 CAS). N. Fork Yager Cr. at Bridgeville-Kneeland

Road, 1300', 66-08-08, H. B. Leech (0/2 CAS). Stream under Blair road at 1950', 3 mi. airline WSW Hoopa, 70-08-14, H.B. Leech (4/3 CAS). Toss-up Creek, confluence with Redwood Cr., 2.5 mi. N. road to Hoopa, 70-08-13, H.B. Leech (2/4 CAS). Redwood Creek, Redwood Valley, 3 mi. N. of road to Hoopa. 70-08-12, H.B. Leech (0/1 CAS). Lake Co.: Headwaters, Long Valley Creek, 55-08-01, H.B. Leech (3/3 CAS). Lucerne, foul pool, dried bed of Cottage City Creek, 55-07-30, H.B. Leech (1/0 CAS). Bartlett Creek, Bartlett Springs, 55-08-01, H.B. Leech (2/0 CAS). Lucerne, creek behind Cottage City Resort, 53-07-05, H.B. Leech (1/1 CAS). Kelsey Creek, Kelseyville, 49-05-29, H.B. Leech (0/1 CAS). 6.9 mi. N. Middletown, R.A. Badger Ranch, ephemeral stream, 55-02-20, H.B. Leech (21/32 CAS). Bear Cr. at Crabtree Hot Sprs. Rd., 55-08-04, H.B. Leech (1/1 CAS). Rice Fork of Eel River at Crabtree Hot Sprs., 57-08-09, H.B. Leech (1/3 CAS). 12 mi. N. Upper Lake, 65-03-18, J. Doyen (2/1 UCB). Middle Cr., 5 mi. N. Upper Lake, 55-08-04, H.B. Leech (3/2 CAS). Los Angeles Co.: San Gabriel Mts., no date, no collr. (1/0 CU). Mts. nr. Claremont, no date, no collr. (1/2 CMP). Pomona Mts., no date, no collr. (2/0 MCZ). No site, no date, no collr. (1/0 USNM). Marin Co.: Mill Valley, 52-04-04, H.B. Leech (0/1 CAS). As above, 52-04-27, (0/1 CAS). Novato, 52-04-17, H.B. Leech (0/1 CAS). Redwood Cr. at Hwy. 1, 71-10-24, P.D. Perkins (1/2 PDP). Carson Ridge, Woodacre, 56-01-09, H. B. Leech (3/3 CAS). Lake Lagunitas, 19-09-01, no collr. (1/0 CAS). Lagunitas Cr. at Tocaloma, 68-05-04, H.B. Leech (1/0 CAS). Cypress Ridge, 57-05-16, D. Giuliani (1/0 CAS). Fairfax, no date, F.E. Blaisell (2/2 CAS). Mill Valley, 57-04-25, H.B. Leech (3/1 CAS). Mill Valley, Cascade Cr., 51-05-09, H.B. Leech (2/5 CAS). As above, 52-04-04, R.E. Leech (2/6 CAS). Lagunitas Cr. at Tocaloma, 68-05-04, H.B. Leech (1/0 CAS). Tocaloma, pool at culvert, 68-05-04, H.B. Leech (1/11 CAS). Rock Spring, Mt. Tamalpais, Cataract Creek, 52-05-25, H.B. Leech (0/1 CAS). no site, 19-11-08, H. Dietrich (1/0 CU). Mendocino Co.: Mendocino, 57-07-21, J.R. Helfer (2/1 CAS). Longvale Cr., 38-07-27, Van Dyke (1/0 CAS). McDowell Cr. just below Oasis, 1800', 55-07-27, H.B. Leech (8/6 CAS). McDowell Cr. at foot of grade below Oasis, 1000', 55-07-27, H.B. Leech (0/2 CAS). Williams Cr. at Covelo-Paskenta Rd., 68-07-17, H.B. Leech (0/2 CAS). Beebe Cr., 50-09-05, H. B. Leech (1/1 CAS). Twin Rocks, 29-07-10, Van Dyke (5/2 CAS). Parson Cr., 4.5 mi. NE Hopland, 64-06-30, H.B. Leech (4/12 CAS). 1 mi. S. Tatu, Longvale-Dos Rios Rd., Rodeo Creek, 68-07-17, H.B. Leech (0/1 CAS). Mendocino, 57-07-06, J.R. Helfer (0/1 CAS). Mill Cr., just W. of Mailliard Redwoods S. P., 64-09-06, H.B. Leech (1/1 CAS). Eel River N. of Potter Valley, 50-09-02, H.B. Leech (0/1 CAS). Rancheria Cr., 5.5 mi. SE Boonville, 0-06-15, H.B. Leech (7/4 CAS). Rattlesnake Cr., Cummings, 48-09-14, H.P. Chandler (2/0 CAS). Napa Co.: 6 mi. NE Rutherford, 71-07-16, P.D. Perkins (1/3 PDP). Nevada Co.: Graniteville, 52-08-22, P.S. Bartholomew (1/2 CAS). Riverside Co.: Palm Springs, no date, Hubbard and Schwarz (1/5 USNM). Santa Barbara Co.: Santa Cruz Island, 70-09-19, P.D. Perkins (3/9 PDP). Santa Inez Mts., no date, no collr. (1/3 CAS). Clear Creek, Cuyama Cyn., 37-03-07, E. Ross, H.B. Leech & M. Cazier (0/1 CAS). Santa Barbara, no date, F.E. Winters (0/1 CAS; 1/2 CU). Santa Cruz Co.: Zayante Creek, 72-06-03, J.E. Cronin (1/0 JEC). Santa Cruz Mts., no date, no collr. (1/6 CAS). Zayante, 47-08-26, no collr. (0/1 CAS). Santa Cruz Mts., no date, A. Koebele (2/3 USNM). Sierra Co.: N. Fork Yuba R. above Indian Valley, 61-08-26, H.B. Leech (1/0 CAS). Siskiyou Co.: Shasta Retreat, 2416', no date, no collr. (2/0 CAS). Etna Creek 1.5 mi. SW of Etna, 3100', 70-08-20, H.B. Leech (1/2 CAS). No site, no date, no collr. (0/1 CAS). Sonoma Co.: Guerneville, 08-07-23, F.E. Blaisdell (1/2 CAS). Mark West Creek at Calistoga Rd., ca. 4 mi. S. Petrified Forest, 63-07-08, H.B. Leech (1/0 CAS). Duncan Mills, 05-07-25, F.E. Blaisdell (1/0 CAS). Camp Meeker, no date, Wintersteiner (1/1 CAS). Duncan Mills, 08-07-14, F.E. Blaisdell (2/0 CU). Duncan Mills, 08-07-14 (1/0 UMI). Duncan Mills, 08-07-14, no collr. (3/1 CFMNH). Duncan Mills, 08-07-24, no collr. (1/0 USNM). Tehama Co.: 1 mi. SW Government Camp, clear mt. stream, 6000', 60-07-29, H.B. Leech (2/1 CAS). Dead Mule Spring, 3 km by road N. of Paskenta-Covelo Rd., 1570 m, 72-08-29, H.B. Leech (1/0 CAS). Trinity Co.: Mad River, 6 mi. S. Ruth, 60-07-31, H.B. Leech (8/6 CAS). Wilson Cr., Lake Mtn. area, 60-07-30, H.B. Leech (5/3 CAS). S. Fork Van Horn Cr., 2 mi. from mouth at Upper Mad R., moss-edged rock pools in running stream, open area, 3000', 70-08-09, H.B. Leech (6/6 CAS). Mad River at route 36, nr. Mad River Park, 68-07-20, H.B. Leech (2/1 CAS). Little Brown Cr. at route 3, ca. 3 mi. airline SW Douglas City, 70-08-11, H.B. Leech (6/1 CAS). Bridge Gulch Creek at Natural Bridge, 7.5 mi. airline N. Wildwood, 70-08-10, H.B. Leech (1/4 CAS). Calistoga, 34-06-12, Bryant (7/12 CAS). Van Horn Cr., 1.5 mi. above its mouth at upper Mad River, clear water pools in gravel and stones of otherwise dry and shaded creek bed, 2850', 70-08-09, H.B. Leech (12/15 CAS). Kerlin Cr. at Hyampom-Big Slide Rd., 68-07-23, H.B. Leech (3/1 CAS). Scott Mtn. Summit campground, Callahan-Carrville Rd., pool, small stream in drying Darlingtonia bog by camp, 5403', 70-08-22, H.B. Leech (0/1 CAS). Hayfork Cr. at Hayfork-Wildwood Rd., 70-08-11, H.B. Leech (0/2 CAS). Mad River just above mouth Van Horn Cr., 4.25 air miles SE Ruth, pools in drying bed of upper Mad River, 70-08-08, H.B. Leech (0/1 CAS). Mad River at Route 36, nr. Mad River Park, 68-07-20, H.B. Leech (1/0 CAS). Tulare Co.: Sequoia N. Park, no date, F.E. Winters (1/0 CU). Unspecified Co.: No site, no date, no collr. (1/0 USNM). Oregon: Grant Co.: Spring at SE corner Grant Co., 67-10-14, J. Schuh (1/0 JS). Multonomah Co.: Portland, no date, Hubbard & Schwarz (3/0 USNM).

3. *Hydraena occidentalis* new species

Map: Figure 23B
Paratypes: 221

Canada: British Columbia: Creston, 30-04-25, G. Stace Smith (1/1 CFMNH). Salmon Arm, Salmon River, 33-10-14, H. B. Leech (1/2 CAS). Salmon Arm, Pumphouse pool, Miles' Creek, 41-03-25, H. B. Leech (1/0 CAS). Salmon Arm, Salmon River, 33-10-06, H.B. Leech (0/1 CAS). Frazier Valley, no date, no collr. (3/0 USNM). Terrace, no date, M.E. Hippisley (3/2 CU). Squamish, 62-07-01, J.L. Carr, (1/1 JLC). Creston, 30-04-25, G. Stace Smith (1/2 UBC). Creston, ephemeral pond, 2000', 53-04-06, G. Stace Smith (1/0 UBC). Royal Oak, V. I., 53-08-13, E. Argyle (1/0 UBC). Silverhope Cr., 9 mi. S. Hope, 71-07-23, P.D. Perkins (3/3 PDP). Cranbrook, 56-08-12, no collr. (0/3 UBC).

United States: California: Contra Costa Co.: Moraga, 37-04-18, H.B. Leech (1/0 CAS). El Dorado Co.: Strawberry, 57-09-02, P.S. Bartholomew (2/3 CAS). Humboldt Co.: Conley Cr., 0.8 mi. SE Blocksburg, 1350', 68-07-09, H.B. Leech (1/2 CAS). Willow Cr., 16-06-14, F.E. Blaisdell (1/3 CAS). Martin Cr., 10 mi. S. Bridgeville, 1150', 68-07-19, H.B. Leech (0/1 CAS). Orick, 38-05-17, H.B. Leech (1/0 CAS). South Dobbyn Cr., Alderpoint-Blocksburg Rd., margin of Typha pool, 450', 68-07-19, H.B. Leech (1/7 CAS). Lake Co.: Middle Cr., 5 mi. N. Upper Lake, 55-08-04, H.B. Leech (1/2 CAS). Scott Cr., 2.75 mi. S. of Lower Blue Lake, 55-08-05, H.B. Leech (1/2 CAS). Hidden Lake, 4 mi. NW of Lakeport, 55-08-05, H.B. Leech (0/1 CAS). Lucerne, pond, 49-05-28, H.B. Leech (0/1 CAS). Little Blue Lake, 1500', 47-11-08, H.P. Chandler (1/0 CAS). Los Angeles Co.: No site, no date, Coquillet (1/0 CAS). Mts. nr. Claremont, no date, no collr. (4/0 CMP). Madera Co.: Northfork, 20-03-07, H. Dietrich (1/1 CU). Marin Co.: Carson Ridge, Woodacre 56-01-09, H.B. Leech (1/0 CAS). No site, 19-11-08, H. Dietrich (1/0 CU). Mariposa Co.: Tenaya L., 45-09-11, G.P. Mackenzie (1/1 LACM). Mendocino Co.: 7 mi. E. of Route 101 on Longvale-Covelo Rd., Bloody Rum Creek, 1100', 68-07-18, H.B. Leech (5/3 CAS). 1 mi. S. Covelo, Grist Creek, 68-07-17, H.B. Leech (0/1 CAS). 1 mi. N. Covelo, W. Branch Mill Cr., 68-07-17, H.B. Leech (1/0 CAS). 2 mi. NW Philo, Hendy Woods S.P., Navarro River, 64-07-22, P. Rubtzoff (1/0 CAS). Mendocino, 57-07-21, J.R. Helfer (0/1 CAS). Mendocino, ex moss in bed of dried-up woodland pool, Berlese funnel, 54-08-07, J.R. Helfer (0/1 CAS). Parson Cr., 4.5 mi. NE of hopland, 64-06-30, H.B. Leech (1/0 CAS). 15 mi. W. Willits, stream, 48-06-15, H.B. Leech (2/1 CAS). Monterey Co.: Salinas, no date, no collr. (1/0 CU). Little Sur R. at Hwy. 1, 71-10-24, P.D. Perkins (1/0 PDP). Napa Co.: No site, no date, no collr. (1/0 USNM). Calistoga, 34-06-12, Bryant (6/3 CAS). No site, no date, no collr. (0/2 CAS). Placer Co.: Penryn, no date, no collr. (1/1 CAS). Riverside Co.: San Jacinto Mts., no date, F.E. Winters (3/13 CU). Riverside, no date, F.E. Winters (2/2 CU). Santa Barbara Co.: Santa Barbara, no date, F.E. Winters (3/7 CU). Santa Clara Co.: Stanford Univ., 57-03-24, P.S. Bartholomew (1/0 CAS). Siskiyou Co.: Salmon Trinity Alps Wilderness Area, Big Hat Camp, Josephine Creek at Carter's Trinity Alps Lodge, 5150', 68-08-02, H.B. Leech (1/0 CAS). Sonoma Co.: Sonoma Creek, Glen Ellen, 50-04-29, H.B. Leech (3/5 CAS). Duncan Mills, 09-07-26, F.E. Blaisdell (1/0 CAS). Tehama Co.: 12 mi. SW Red Bluff, Montgomery FFS, 72-06-25, D.S. Chandler (1/0 US). As above, 72-07-14 (0/1 UA). Oregon:Clackamas Co.: 4 mi. S. Newberg, BL trap, 69-08-11, no collr. (1/0 ODA). Coos Co.: Coos Bay, 51-07-09, B. Malkin (0/2 CFMNH). Curry Co.: Pistol River, 56-09-17, B. Malkin (1/2 CFMNH). As above, 52-06-18 (0/1 CFMNH). B. Malkin & V.E. Roth (0/1 CFMNH). Klamath Co.: Aspen Lake, 57-05-05, J. Schuh (1/1 JS; 1/4 NMD; 2/1 WRS). Lane Co.: Eugene, BL trap, 68-07-29, no collr. (0/1 ODA). Lincoln Co.: 5 mi. S. Newport, BL trap, 61-08-01, no collr. (0/1 ODA). Polk Co.: West Salem, 71-06-20, R.L. Westcott (0/1 ODA). Washington: King Co.: Green River Gorge, 56-07-15, B. Malkin & R. Kottke (19/24 CFMNH). Thurston Co.: Olympia, no date, no collr. (2/2 MCZ). Whatcom Co.: Lynden, 68-04-21, L. Russell (1/1 NMD). Whitman Co.: Pullman, no date, C.V. Piper (1/0 USNM).

4. *Hydraena tuolumne* new species

Map: Figure 23E
Paratypes: 46
United States: California: Calaveras Co.: Big Trees, 37-09-13, F.E. Blaisdell (1/0 CAS). Fresno Co.: S. Fk. Tamarack Cr. at Tamarack Meadow, ca 6 mi. airline south of Huntington L., pools in drying streambed, 7440', 71-09-02, H.B. Leech (1/0 CAS). Florence Lake, 50-08-24, P.S. Bartholomew (1/0 CAS). Stream from E. entering S. Fk. San Joaquin R. at gauging station by N. end Jackass Dike, N. of Florence Lake, 7200', 71-08-31, H.B. Leech (1/0 CAS). Wishon vicinity, 70-08-02, D.G. Marqua (1/0 PDP). Madera Co.: E. fork Granite Creek at road to Soldier Meadow, 71-08-23, H.B. Leech (14/20 CAS). Chiquito Creek at bridge, Clover Mdw. road, 6800', 71-08-11, H.B. Leech (1/0 CAS). N. Fork San Joaquin River at Sheep Crossing, 6000', 71-08-22, H.B. Leech (1/0 CAS). Nevada Co.: Shotgun L., 23-07-13, J.O. Martin (1/1 CAS). Upper Truckee River, 52-08-19, P.S. Bartholomew (1/0 CAS). Tuolumne Co.: Same data as Holotype (2/0 Cas).

5. *Hydraena angulicollis* Notman

Map: Figure 25A
Specimens examined: 184
Canada: Alberta: Tp. 38 Rge. 5 W. 5 Mer., 72-09-16, B. & J. Carr (2/1 JLC). Tp. 28 Rge. 5 W. 5 Mer., 72-10-06,

B. & J. Carr (1/0 JLC). Jumpingpound Cr., 72-05-13, Carr (0/1 JLC). Tp. 37 Rge. 5 W. 5 Mer., 72-09-10, B. & J. Carr (0/3 JLC). Tp. 38 Rge. 6 W. 5, 72-09-16, B. & J. Carr (0/1 JLC). Tp. 37 Rge. 5 W. 5 Mer., 72-05-27, B. & J. Carr (0/1 JLC). Tp. 25 Rge. 5 W. 5 Mer., 72-05-23, B. & J. Carr (0/1 JLC). Edmonton, 18-04-18, F.S. Carr (1/0 UM). Edmonton, 17-09-15, F.S. Carr (0/1 CAS). Edmonton, 19-04-19, F.S. Carr (0/1 CNC). Edmonton, 19-06-19, F.S. Carr (0/1 CNC). Edmonton, 19-06-19, F.S. Carr (3/3 CAS). Edmonton, 18-04-04, F.S. Carr (0/1 CAS). Edmonton, 19-08-28, F.S. Carr (0/1 CAS). Edmonton, 19-04-19, F.S. Carr (1/1 CAS). Manitoba: Ninette, in shore debris, 58-05-06, R.B. Madge (0/1 CNC). Northwest Territories: 3.5 mi. SE Ft. Simpson, 72-06-21, A. Smetana (1/0 CNC). As above, 72-06-17, A. Smetana (0/1 CNC). Norman Wells, 49-06-10, S.D. Hicks (0/2 CNC). Ontario: Algonquin Park, lake of two rivers nature trail, 60-05-25, B.V. Peterson (0/1 CNC). Dryden, small lake edge, 70-09-04, E.J. Kiteley (1/0 EJK). Quebec: Wakefield, 31-08-07, W.J. Brown (7/7 CNC). As above, 30/06-04, W.J. Brown (0/3 CNC). Duchesnay, 42-07-08, J.I. Beaulne (0/1 CNC). Kazubazua, 31-08-18, W.J. Brown (3/3 CNC). As above, 28-08-26, W.J. Brown (2/3 CNC). Tremblant, Parc du Mont, 58-05-28, A. Robert (1/0 UM). As above, 58-06-09 (1/0 UM). As above, 58-06-13 (0/1 UM). As above, 58-05-26 (0/1 UM). Duparquet, 35-08-02, G. Stace Smith (1/0 CAS). As above 37--8-18 (0/1 CAS). Knowlton, 30-06-05, L.J. Milne (0/1 CNC).

United States: Connecticut: Fairfield Co.: No site, no date, no collr. (0/1 USNM). Litchfield Co.: Cornwall, 22-04-30, K.F. Chamberlain (2/0 JFB). Indiana: Kosciusko Co.: No site, 08-06-24, W.S. Blatchley (0/2 PU). Maine: Penobscot Co.: Corinth, 69-07-22, S. Malcolm (0/1 DCM). Maryland: Anne Arundell Co.: Odenton, 18-07-14, H. Dietrich (1/0 USNM). Massachusetts: Middlesex Co.: Tyngsboro, no date, no collr. (1/0 USNM). Tyngsboro, 1873-12-01, no collr. (5/4 MCZ). Tyngsboro, no date, no collr. (1/0 USNM). Norfolk Co.: Natick, 49-04-13, C.A. Frost (1/0 CAS). Unspecified Co.: No site, no date, no collr. (1/0 MCZ). Michigan: Emmet Co.: 4 mi. E. Levering, 52-08-05, P.J. Spangler (1/0 USNM). Maple River, 52-08-08, P.J. Spangler (1/0 USNM). Livingston Co.: E.S. George Reserve, Big Swamp, 52-07-04, F.N. Young (1/1 UMI). E.S. George Reserve, 50-04-17, I.J. Cantrall (1/0 FNY). Mackinac Co.: 4 mi. E. Engadine, 72-08-21, W.R. Suter (5/3 USNM). Marquette Co.: Marquette, no date, Hubbard and Schwarz (0/1 USNM). Minnesota: Clearwater Co.: Itasca State Park, 27-11-01, S. Garthside (1/0 USNM). Mille Lacs Co.: 2 mi. E. and 2 mi. S. Onamia, from leaf litter using a Berlese funnel, 65-07-05, P.J. Clausen (4/3 UMA). Onamia, 65-06-19, P.J. Clausen (1/0 UMA). New Hampshire: Grafton Co.: Franconia, no date, no collr. (0/1 AMNH). Hillsboro Co.: Antrim, 42-10-16, C.A. Frost (1/1 CAS). New Jersey: Morris Co.: Towaco, sifting leaves, 44-11-07, A. Nicolay (0/1 USNM). New York: Hamilton Co.: Hope (N.): Hope Falls Road, sphagnum, streamside alder swamp, 74-08-25, W.R. Suter (41/22 USNM). Oneida Co.: Cold Brook, 16-06-30, W.A. Clemens (0/1 USNM). Orange Co.: West Point, 10-05-21, W. Robinson (1/0 USNM). Ohio: Unspecified Co.: No site, no date, F.C. Bowditch (1/1 MCZ). Vermont: Bennington Co.: No site, no date, no collr. (1/0 USNM: 1/0 CU). Windsor Co.: Woodstock, no date, Wintersteiner (1/1 CU).

7. *Hydraena nigra* Hatch

Map: Figure 27F

Specimens examined: 116

Canada: British Columbia: Fernie, 34-06-05, H.B. Leech (0/1 CAS). Trinity Valley, trib. to Vance Creek, 46-10-03, H.B. Leech (7/3 CAS; 1/1 CNC; 0/1 UBC). Fernie, Lizard Creek, 34-08-27, H.B. Leech (0/1 CAS). Fernie, 34-06-05, H.B. Leech (0/2 CAS).

United States: California: El Dorado Co.: Gln. Alpine, no date, A. Fenyes (1/1 CFMNH). 2 mi. SSE Quintette, trib. Whaler Cr., 63-07-27, H.B. Leech (3/1 CAS). Fresno Co.: Stream from E. entering S. Fork San Joaquin R. at gauging station by N. end Jackass Dike, N. of Florence Lake, 7200' , 71-08-31, H.B. Leech (1/0 CAS). Kern Co.: Shirley Cr. at Glenville-Kernville Rd., Greenhorn Mts., 5500', 70-03-25, H.B. Leech (0/1 CAS). Lassen Co.: Norval Flats, 5500', 20-07-04, no collr. (5/3 CAS). Madera Co.: Boggy Mdws., 6000', 45-07-15, no collr. (0/1 CAS). Mariposa Co.: NE slope Chowchilla Mts., bog by Stove Pipe campground, 6100', 71-08-06, H.B. Leech (0/1 CAS). Nevada Co.: Sagehen Cr., 66-06-22, W.J. Turner (1/1 UCB). Placer Co.: Lake Tahoe, no date, Hubbard and Schwarz (0/1 USNM). Lake Tahoe, no date, no collr. (1/0 LACM). Riverside Co.: San Jacinto Mts., no date, F.E. Winters (1/0 CAS; 1/0 CU). Siskiyou Co.: Wolf Cr., Scott Mts. S. of Callahan, 5200', 70-08-24, H.B. Leech (0/1 CAS). Fox Lake Road, headwaters Blue Jay Creek, 5000', 70-08-24, H.B. Leech (2/4 CAS). Tulare Co.: Sequoia N. Park, no date, F.E. Winters (5/16 CU). Tuolumne Co.: Trib. Niagara Cr., Niagara Cr. Forest Campground, 63-08-11, H.B. Leech (5/8 CAS). Pinecrest, 47-07-15, P.H. Arnaud, Jr. (1/1 CAS). Colorado: Chaffee Co.: Buena Vista, no date, no collr. (1/0 USNM). Buena Vista, 7900'-8000', 1896-07-01, H.F. Wickham (0/8 USNM). El Paso Co.: 6 mi. W. Colorado Sprs., Gold Camp Road, 9500', 73-06-06, A.R. Gillogly (4/4 PDP). Oregon: Klamath Co.: 8 mi. NE Bly, Deming Creek, 67-08-19, J. Schuh (3/0 JS). 12 mi. NE Bly, Long Creek, 67-09-24, J. Schuh (2/3 JS). 15 mi. NE Bly, Deming Creek, 66-08-05, J. Schuh (1/1 JS). Utah: Cache Co.: Logan Canyon, in moss, 74-10-20, G.F. Knowlton (1/0 USNM). Garfield Co.: Canyon City, no date, Hubbard & Schwarz (2/0 USNM). Uintah Co.: Cub River Cyn., 56-12-04, G.F. Knowlton (0/1 OSU).

8. *Hydraena atlantica* new species

Map: Figure 25B

Paratypes: 199

Canada: Quebec: Tremblant, Parc du Mont, 52-06-12, A. Robert (0/1 UM). As above, 58-05-28 (1/2 UM). As above, 58-05-24 (0/1 UM). As above, 58-05-30 (0/1 UM). Kazubazua, 31-08-18, W.J. Brown (1/0 CNC).

United States: Connecticut: Fairfield Co.: No site, no date, no collr. (5/6 USNM; 2/2 MCZ). Litchfield Co.: Litchfield, 22-04-28, L.B. Woodruff (1/0 AMNH). Illinois: Unspecified Co.: No site, no date, no collr. (0/1 CU). Maine: Cumberland Co.: North Yarmouth, 67-08-16, P.J. Spangler (2/0 USNM). Maryland: Anne Arundel Co.: Odenton, 18-07-14, H. Dietrich (0/2 USNM). Montgomery Co.: Plummer's Island, in pothole, 72-04-01, P.J. Spangler (1/0 USNM). As above, 72-04-19, P.J. Spangler (3/6 USNM). Plummer's Island, 72-04-19, P.J. Spangler (1/0 USNM). C. & O. Lock at Plummer's Island, 60-06-29, P.J. Spangler (2/0 USNM). As above, 61-06-07 (4/1 USNM). Prince Georges Co.: Bladensberg, no date, no collr. (1/2 CU). Talbot Co.: Easton , woodland pond, 71-07-19, P.J. Spangler (1/0 USNM). Easton, Seth State Forest, 74-06-19, P.J. Spangler (1/0 USNM). As above, 76-05-13 (15/25 USNM). Massachusetts: Bristol Co.: Fall River, 08-08-28, N.S. Easton (1/0 MCZ). Fall River, no date, N.S. Eston (0/4 CAS). Hampden Co.: West Springfield, 03-08-03, F. Knab (1/0 USNM). Middlesex Co.: Sherborn, no date, no collr. (1/0 CU). Framingham, pasture pool, 35-05-10, C.A. Frost (1/0 CAS). Norfolk Co.: Brookline, no date, F.C. Bowditch (1/0 MCZ). Plymouth Co.: Marion, no date, no collr. (2/0 MCZ). Suffolk Co.: Boston, no date, no collr. (1/0 MCZ). Tyngsboro, no date, no collr. (1/4 CU). Unspecified Co.: No site, no date, no collr. (1/0 CMP; 2/0 SDSU). Lawrence, no date, no collr. (1/0 CFMNH). Michigan: Eaton Co.: Grand Ledge, no date, Hubbard & Schwarz (0/3 USNM). New Hampshire: Merrimack Co.: Danbury, no date, no collr. (1/0 USNM). Stafford Co.: Lee, 61-07-25, R.L. Blickle (1/0 UNH). Unspecified Co.: No site, no date, no collr. (1/0 USNM). Three Mile Island, 27-05-08, no collr. (1/0 MCZ). New Jersey: Bergen Co.: Seacaucas, no date, Wintersteiner (1/3 CU). Hackensac, no date, Wintersteiner (2/2 CU). Westwood, No date, no collr. (1/0 CU). Westwood, 19-07-01, no collr. (3/2 AMNH). Oradell, 18-04-07, E.D. Quirsfeld (1/0 USNM). Oradell, 18-04-06, E.D. Quirsfeld (1/0 JFB). Mercer Co.: Trenton, 10-03-29, H.B. Kirk (1/0 PBPI). Passaic Co.: Paterson, 10-04-01, no collr. (0/2 AMNH). Unspecified Co.: Snake Hill, no date, no collr. (1/4 AMNH). No site, no date, no collr. (1/1 CAS; 1/1 USNM). As above, Wintersteiner (4/0 CU). New York: Richmond Co.: Staten Island, 16-0930, no collar. (0/1 USNM). Staten Island, no date, no collr. (1/0 CAS). Staten Island, 91-07-07, no collr. (0/1 USNM). Suffolk Co. Long Island, no date, no collr. (1/2 MCZ). As above, Wintersteiner (10/2 CU). Long Island, Forest Park, no date, no collr. (8/6 CU). Long Island, Shelter Island, 40-05-29, R. Latham (1/0 CU). Tompkins Co.: Ithaca, 15-04-14, no collr. (01 CU). Ithaca, 55-04-30, H. Dietrich (0/2 CU). Westchester Co.: New Rochelle, 10-08-03, L. Lacey (0/2 AMNH). Unspecified Co.: No site, no date, no collr. (1/0 UMA; 0/1 USNM). No site, no date, C. Palm (1/2 AMNH). Pennsylvania: Delaware Co.: Castle Rock, no date, H.A. Wenzel (2/0 OSU). Unspecified Co.: No site, no date, F.C. Bowditch (1/1 MCZ). Rhode Island: Newport Co.: Tiverton, 12-10-20, Dodge (1/1 PMNH). Washington Co.: Kingston, 21-02-04, no collr. (0/1 CU). South Carolina: Charleston Co.: No site, 66-10-13, R.E. Widdows (1/1 CFMNH). Vermont: Bennington Co.: No site, no date, no collr. (15/11 USNM; 1/0 CMP; 0/1 CU). Virginia: Unspecified Co.: Fort Monroe, no date, no collr. (1/1 USNM). Wisconsin: Sauk Co.: Sauk City, 99-08-02, no collr. (1/1 MCZ). Sauk City, 99-08-09, no collr. (1/4 UW).

9. *Hydraena pacifica* new species

Map: Figures 27A-C

Paratypes: 634

Canada: Alberta: Pincher Creek, no date, no collr. (2/3 MCZ). Coleman, 58-08-04, J.L. Carr (2/1 JLC). 6 mi. S. Pincher Creek, 71-07-01, P.D. Perkins (1/0 PDP). British Columbia: Terrace, no date, M.E. Clark (1/2 MCZ). Quesnel Lake, no date, no collr. (1/3 MCZ). Fernie, Elk River, 34-07-26, H.B. Leech (4/3 CAS). Fernie, 34-06-05, H.B. Leech (1/1 CAS). Terrace, no date, M.E. Clark (4/0 CAS). Trinity Valley, tributary to Vance Creek, 46-10-03, H.B. Leech (6/8 CAS). As above, 44-07-12 (2/0 CAS). As above, 37-09-12 (1/3 CAS). As above, 40-06-13 (0/1 CAS). Kamloops, in a swamp, 39-07-30, G. Spencer (0/2 CAS). Terrace, Lost lake, no date, M.E. Hippisley (1/0 CAS). British America, Ft. McLeod, no date, no collr. (2/0 USNM). Terrace, no date, M.E. Hippisley (2/0 CU). Princeton, 30-05-25, G. Stace Smith (1/0 UBC). Wynndel, head of Lizard Creek, 47-08-28 (2/1 UBC). As above, 46-10-05 (1/2 UBC). As above, 45-10-07 (1/0 UBC). Wynndel, Duck Creek, 31-07-18, G. Stace Smith (0/1 UBC). As above, 31-07-10 (0/1 UBC). Wynndel, Lizard Creek, 2600', 47-10-12, G. Stace Smith (1/0 UBC). Copper Mtn., 30-03-28, G. Stace Smith (5/6 UBC). As above, 30-05-04 (1/1 UBC). As above, 30-09-04 (1/0 UBC). As above, 30-03-29, (2/1 CNC). As above, 29-05-17 (0/2 CNC). Creston, ephemeral pond, 2000', 52-03-21, G. Stace Smith (1/1 UBC). Royal Oak V. I., evening flight, 53-07-17, E. Argyle (1/2 UBC). Terrace, no date, M.E. Clark (1/4 MCZ). Quesnel Lake, no date no collr. (1/3 MCZ). Lister, Rykert Creek, 47-07-02, G. Stace Smith (2/4 UBC).

United States: California: Fresno Co.: Ca 6 mi. S. Huntington Lake, S. Fork Tamarack Cr. at Tamarack Meadow, pools in drying streambed, 7440', 71-09-02, H.B. Leech (3/9 CAS). N. of Huntington Lake, 71-08-25, H.B. Leech

(11/17 CAS). NE of Huntington Lake, Kaiser Pass Meadow, 9025', 71-08-27, H.B. Leech (46/60 CAS). N. of Florence Lake, stream from E. entering S. Fork San Joaquin R., at gauging station by N. end Jackass Dike, 7200', 71-08-31, H.B. Leech (0/1 CAS). Glenn Co.: Plaskett Mdws., margins of Upper Plaskett Lake, 6000', 60-07-29, H.B. Leech (10/13 CAS). 4.5 mi. S. Mendocino Pass, collecting stop No. 5, 6500', 60-07-29, H.B. Leech (0/4 CAS). Inyo Co.: Cottonwood Cr., ex waterlogged limb in stream, 10,000', 71-05-16, P.D. Perkins (2/6 PDP). Lassen Co.: Duck Lake, 21-05-08, J.O. Martin (1/1 CAS). Facht, 21-05-24, no collr. (1/3 CAS). Los Angeles Co.: Pomona, no date, no collr. (1/0 MCZ). Madera Co.: Jackass Creek, E. end Jackass Meadow, 6960', 71-08-17, H.B. Leech (9/8 CAS). Chiquito Creek, at bridge Clover Meadow Road, 6800', 71-08-11, H.B. Leech (1/2 CAS). E. Fork Granite Creek at road to Soldier Meadow, 6960', 71-08-23, H.B. Leech (1/0 CAS). Branch, Granite Cr., 0.15 mi. W. Soldier Meadow, 6965', 71-08-17, H.B. Leech (0/1 CAS). Chiquito Creek, 0.25 mi. below upper Chiquito campground, 6820', 71-08-11, H.B. Leech (0/1 CAS). Mariposa Co.: Yosemite N. Park, Snow Flat, 46-09-07, H.P. Chandler (1/0 CAS). Mirrow Lake, 55-08-21, P.S. Bartholomew (0/6 CAS). Tenaya L., 45-09-11, G.P. Mackenzie (2/1 LACM; 2/0 NMD). Nevada Co.: Sagehen Creek, nr. Hobart Mills, 66-06-26, W.J. Turner (2/0 UCB). Sagehen Cr., 66-06-23, W.J. Turner (1/0 UCB). Upper Truckee R., 52-08-19, P.S. Bartholomew (1/0 CAS). Siskiyou Co.: 6.25 mi. airline SW Etna, stream flowing into Meeks Meadow, 1925 m, 72-08-23, H.B. Leech (9/13 CAS). S. of Callahan, East Boulder Lake, Scott Mts., 6680', 70-08-25, H.B. Leech (4/1 CAS). Poker Flat, head of W. Branch Indian Creek, 5040', 66-08-14, H.B. Leech (6/2 CAS). 6.25 mi. airline SW Etna, murky flood pool by stream flowing into Meeks Meadow Lake, 72-08-23, H.B. Leech (34/51 CAS). Fox Lake Road, headwaters Blue Jay Creek, 5000', 70-08-24, H.B. Leech (3/0 CAS). Taylor Lake, Salmon Mts., small stream, meadow south end Taylor Lake, 6500', 70-08-20, H.B. Leech (9/10 CAS). Tiny creek, NW side Scott Mt., 6660', 66-08-20, H.B. Leech (1/1 CAS). Headwaters E. Fork of S. Fork Salmon River, Cecilville-Callahan Road, 6000', 68-07-31, H.B. Leech (2/6 CAS). Stream in Darlingtonia Bog, source Big Carmen Creek, NNW slope Scott Mtns., 70-08-23, H.B. Leech (2/2 CAS). Upper Boulder Lake, 6780', Scott Mtns., S. of Callahan, 70-08-25, H.B. Leech (0/1 CAS). Etna Road, N. Russian Creek at foot Jumpoff Joe Curve, 3640', 70-08-17, H.B. Leech (0/1 CAS). Meeks Meadow lake, 6.25 mi. airline SW Etna, 1872 m, 72-08-23, H.B. Leech (0/1 CAS). Tehama Co.: Judd Cr., 52-06-25, H.P. Chandler (0/1 CAS). Trinity Co.: Scott Mtn. summit campground, Callahan-Carrville Rd., pools, small stream in Darlingtonia bog by camp, 5403', 70-08-22, H.B. Leech (1/0 CAS). Tuolumne Co.: Tioga, 45-09-11, G.P. Mackenzie (2/1 LACM). Sonora Pass, 58-08-16, D. Giuliani (2/0 CAS). Unspecified Co.: No site, no date, no collr. (1/0 INHS). Colorado: Chaffee Co.: Buena Vista, no date, F.E. Wickham (2/3 USNM). Conejs Co.: Cumbres Creek, E. slope of Cumbres Pass, 9920', 65-08-12, H.B. Leech (2/0 CAS). Costilla Co.: Fort Garland, no date, Hubbard & Schwarz (0/1 USNM). Huerfano Co.: Veta Pass, no date, no collr. (1/1 MCZ). Veta Pass, no date, Hubbard & Schwarz (4/2 USNM). La Veta, no date, Hubbard & Schwarz (0/1 USNM). Veta Pass, no date, no collr. (3/1 MCZ). Routt Co.: Steamboat Springs, 6800', 41-10-01, Bryant (1/0 CAS). Clark, 8000', 47-08-03, Bryant (1/0 CAS). Summit Co.: Fremont Pass, 10,300', 52-08-17, B. Malkin (0/1 CFMNH). Idaho: Bingham Co.: No site, no date, Hubbard & Schwarz (1/1 USNM). Blaine Co.: Alturas Lake, Sawtooth Mts., 52-07-23, B. Malkin (1/1 CFMNH). As above, 52-07-22 (1/1 CFMNH). Custer Co.: Stanely lake, Sawtooth Mts., 52-07-23, B. Malkin (2/1 CFMNH). Montana: Cascade Co.: 7.5 mi. N. Neihart, Belt Creek, 6950', 64-07-21, H.B. Leech (6/8 CAS). Nevada: Elko Co.: E. foot Secret Pass, Hwy. 11 at road from Arthur, 6200', 65-08-26, H.B. Leech (1/3 CAS). Lander Co.: 5 mi. ESE Austin Hwy. 50 at Hwy. 21, 64-08-05, H.B. Leech (0/1 CAS). Washoe Co.: 0.5 mi. E. Top Pass, stream under route 27, E. slope Mt. Rose, 8800', 69-08-27, H.B. Leech (1/0 CAS). Oregon: Clackamas Co.: Clackamas Lake, 40-07-20, no collr. (1/1 MCZ). Harney Co.: Fish Lake, Steens Mts., 51-06-22, B. Malkin (11/9 CFMNH). Klamath Co.: Crescent, Little Deschutes River, 57-05-12, J. Schuh (1/0 JS). Bly, Horse Glades, 55-05-05, J. Schuh (1/0 JS). Lake Co.: Lake City, sweeping plants, springs and seepage, 67-08-02, K. Goeden (2/4 ODA). Lane Co.: 2 mi. N. Junction City, 72-02-12, Ryker (0/1 ORSU). Utah: Cache Co.: Logan Canyon, in moss, 74-10-20, G.F. Knowlton (3/0 USNM). Emery Co.: Wasatch MTts., 47-06-28, Bryant (0/1 CAS). Garfield Co.: Escalante River, mouth of calf creek, 39-08-01, H.P. Chandler (0/2 CAS). City Can., no date, Hubbard & Schwarz (0/1 USNM). Salt Lake Co.: Alta, no date, Hubbard & Schwarz (1/0 USNM). Utah Co.: Timpanogas, Aspen Grove environs, 7000', 41-22-05, H.P. Chandler (1/2 CAS). Hobble Cr. Canyon, 6000', 41-08-09, H.P. Chandler (0/2 CAS). Wasatch Co.: Lost Lake Camp, Uinta Mts., 9800', 40-08-26, H.P. Chandler (0/1 CAS). As above, 40-08-27 (0/1 CAS). As above, 8000', 40-08-26 (1/0 CAS). Tyrol Lake, Uintah Mts., 9800', H.P. Chandler (1/2 CAS). Washington: King Co.: Bothell, 61-03-21, no collr. (0/1 DCM). Green River Gorge, 56-07-15, B. Malkin & R. Kottke (1/0 CFMNH). Wyoming: Uintah Co.: 8.3 mi. W. Fr. Bridger, trib. of muddy Cr., 65-08-23, F.O. Leech (0/1 CAS). Yellowstone National Park: Yellowstone, N. P., Apollinasis Spr., 62-08-17, P. & P.J. Spangler (1/0 USNM). Yellowstone N.P., colld. in Obsidian Creek at Crystal Spring, 62-08-17, P. & P.J. Spangler (6/19 USNM).

Aedeagal morph "B"

Specimens examined: 177

Canada: British Columbia: Jaffray, Little Sand Creek, 50-07-23, H.B. Leech (3/1 CAS). Sumas Prairie, 33-06-03, G. Hopping (1/0 CAS). Agassiz, 31-03-07, H.B. Leech (1/2 CAS). Victoria, Vancouver, no date, Horn (1/0 USNM).

United States: California: Contra Costa Co.: Hills back of Oakland, 08-06-07, no collr. (0/1 CAS). Danville, 51-06-01, F.X. Williams (1/1 CAS). Berkeley, no date, F.E. Winters (0/1 CAS). Del Norte Co.: 2 mi. S. Crescent City, roadside pond, 67-03-29, J. Schuh & D. Vertrees (2/1 JS). 8 mi. NE. Cresent City, Smith River at Hiouchi

bridge, 65-09-30, H.B. Leech (1/0 CAS). Humboldt Co.: Hydesville, no date, no collr. (0/3 CAS). Mad River at Kneeland-Addison Rd., 66-08-09, H.B. Leech (1/0 CAS). Lake Co.: Kelseyville, Kelsey Creek, 49-05-29, H.B. Leech (1/4 CAS). Los Angeles Co.: No site, no date, no collr. (1/5 CU). Marin Co.: Novato, streambed by sifting, 52-06-17, H.B. Leech (15/10 CAS). Fairfax, no date, F.E. Blaisdell, (2/3 CAS). As above, 06-09-09 (0/1 CAS). Lagunitas Creek at Tocaloma, 68-05-04, H.B. Leech (1/0 CAS). Olema, 48-03-01, H.P. Chandler (1/0 CAS). Headwaters of Salmon Dr., Wilson Hill Rd., 64-02-22, H.B. Leech (1/0 CAS). Mariposa Co.: Miami Ranger Station, 5000', 42-07-06, H.P. Chandler (0/1 CAS). 6 mi., E. Miami Ranger Station, 46-07-04, H.P. Chandler (1/0 CAS). Mendocino Co.: Parson Creek 4.5 mi. NE. of Hopland, 64-06-30, H.B. Leech (2/3 CAS). Univ. Cal. Range Exp. Sta., Vasser Corner Creek, 63-06-20, H.B. Leech (1/0 CAS). Grist Creek, 1 mi. S. Covelo, 68-07-17, H.B. Leech (1/0 CAS). Rodeo Creek, 1 mi. S. Tatu, Longvale-Dos Rios Road, 68-07-17, H.B. Leech (2/1 CAS). Mono Co.: Mammoth, 45-09-15, G.P. Mackenzie (1/0 LACM). Monterey Co.: Salinas, no date, no collr. (0/1 CAS). Napa Co.: Rutherford, 51-06-10, H.B. Leech (1/0 CAS). San Mateo Co.: Woodside, Pulgas Temple, 51-06-10, P.S. Bartholomew (0/7 CAS). No site, no date, no collr. (1/0 USNM). Santa Barbara Co.: Santa Barbara, no date, F.E. Winners (1/0 CAS). Santa Clara Co.: Stanford Univ., 57-03-24, P.S. Bartholomew (2/1 CAS). Stanford Univ., Jasper Ridge, 52-05-31, P.S. Bartholomew (2/2 CAS). Sierra Co.: Sierraville, 4950', 47-07-03, H.P. Chandler (3/3 CAS). Sonoma Co.: Duncan Mills, 08-07-26, F.E. Blaisdell (0/1 CAS). Santa Rosa-Calistoga, 50-06-25, P.S. Bartholomew (1/0 CAS). Calistoga, 34-06-12, Bryant (1/0 CAS). Glen Ellen, Sonoma Creek, 50-04-29, H.B. Leech (2/0 CAS). Mark West Cr. at Calistoga Rd., ca 4 mi. S. Petrified Forest, 63-07-08, H.B. Leech (5/6 CAS). Santa Rosa, 65-04-10, J.D. Birchim (1/0 CAS). Tulare Co.: Sequoia N. Park, no date, F.E. Winters (2/0 CU). Unspecified Co.: Waddell, no date, J.E. Cronin (1/1 JEC). Little Miller Creek, 74-08-04, J.E. Cronin (1/0 JEC). Fr. Creek, no date, H.W. Wenzel (2/1 OSU). Oregon: Benton Co.: Corvallis, no date, no collr. (4/21 USNM). Corvallis, 38-05-20, H.B. Leech (1/0 CAS). Corvallis, no date, no collr. (5/12 CU). Corvallis, 72-04-26, L. Ryker (1/0 ORSU). Corvallis, no date, no collr. (3/0 MCZ). 10 mi. S. Corvallis, Winkle Lake, 63-05-10, T. Schuh (0/1 JS). Pub. Golf course pond, 72-06-30, L. Ryker (1/0 ORSU). Granger, 32-04-25, no collr. (1/0 JS). Klamath Co.: Above Geary Ranch, Aspen duff at swamp, 71-10-25, J. Schuh (1/0 JS). Lane Co.: Eugene, 41-06-29, B. Malkin (3/0 CAS). Washington: King Co.: Bothel, 61-03-21, no collr. (1/0 DCM). Bothel, 60-04-16, D. Miller (0/1 DCM).

Aedeagal morph "C"

Specimens examined: 73

Canada: British Columbia: Langley, 31-06-21, K. Graham (1/0 CAS). As above, 35-06-23 (2/2 CAS).

United States: California: El Dorado Co.: Strawberry, 57-09-02, P.S. Bartholomew (1/0 CAS). Fresno Co.: Vic. Wishon, 70-08-02, D.G. Marqua (1/0 PDP). Mariposa Co.: Mirror Lake, 55-08-21, P.S. Bartholomew (1/1 CAS). Mendocino Co.: Rancheria Cr., 5.5 SE Booneville, 50-06-15, H.B. Leech (1/0 CAS). Napa Co.: Burton Cr., Pope Valley, 64-05-10, H.B. Leech (2/2 CAS). Nevada Co.: Upper Truckee River, 52-08-19, P.S. Bartholomew (6/10 CAS). Placer Co.: Emigrant Gap, from pool, 66-07-27, P.H. Arnaud, Jr. (3/7 CAS). Shasta Co.: 2.5 mi. W & S. of Viola, Bailey Creek, 61-08-31, H.B. Leech (1/0 CAS). Sierra Co.: Sierraville, 4950', 47-07-03, H.P. Chandler (3/0 CAS). Siskiyou Co.: No site, no date, F.E. Blaisdell (1/0 CAS). Tulare Co.: Sequoia N. Park, no date, F.E. Winters (2/0 PDP).

10. *Hydraena californica* new species

Map: Figure 23D

Paratypes: 14

United States: California: Humboldt Co.: Redwood Park, 18-08-10, J.O. Martin (1/2 CAS). San Mateo Co.: La Honda, 25-07-29, F.E. Blaisdell (1/0 CAS). Santa Clara Co.: Alma, 27-08-01, J.O. Martin (3/0 CAS). Los Gatos, no date, Hubbard and Schwarz (1/0 USNM). Santa Cruz Co.: Santa Cruz, no date, F.W. Nunenmacher (1/0 UMI). Santa Cruz Mts., no date, Koebele (2/0 CAS). Boulder Creek, 55-01-22, M. Wasbauer (1/0 UCB). Zayante Creek, 72-06-03, J.E. Cronin (0/1 JEC). As above, 73-02-19 (1/0 JEC).

11. *Hydraena petila* new species

Map: Figure 27E

Paratypes: 96

Canada: British Columbia: Vancouver, 33-04-23, H.B. Leech (4/1 CAS; 1/1 CNC).

United States: California: Del Norte Co.: No site, no date, F.W. Nunenmacher (1/1 CFMNH). Gasquet, 50-06-24, P.S. Bartholomew (1/2 CAS). Humboldt Co.: Toss-up creek, confluence with Redwood creek 2.5 mi. N. of road to Hoopa, ca 650', 70-08-13, H.B. Leech (9/13 CAS). Willow creek just above its E. Fork, 1500', 70-08-28, H.B. Leech (2/1 CAS). Conley creek, 0.8 mi. SE Blocksburg, 1350', 68-07-19, H.B. Leech (0/3 CAS). Pool in drying up stream under Route 36, Larabee Valley, 0.8 mi. W. Butte Cr., 2470', 68-07-19, H.B. Leech (0/2 CAS). Burr Cr. 3 mi. S.

Bridgeville, 1200', 68-07-19, H.B. Leech (1/0 CAS). Stream under Bair Rd., tributary to Pine Cr. W. of Hoopa, 70-08-14, 3300', F.O. Leech (2/0 CAS). N. Fork Yager Cr. at Bridgeville-Kneeland Rd., 1300', 66-08-08, H.B. Leech (2/0 CAS). Pepperwood, 07-06-28, Bradley (1/0 CU). Stream under Blair Rd., 3 mi. airline WSW of Hoopa, 1950', 70-08-14, H.B. Leech (0/4 CAS). Mendocino Co.: No site, no date, no collr. (1/1 CAS). Hendy Woods S. P., 68-06-14, L.N. & C.J. Bell (2/2 CAS). Mendocino, 57-07-21, J.R. Helfer (1/0 CAS). 15 mi. W. Willits, stream, 48-06-15, H.B. Leech (1/0 CAS). Twin Rocks, 29-07-10, no collr. (1/0 CAS). Gualala Cr., 51-07-11, P.S. Bartholomew (0/1 CAS). Santa Clara Co.: Stanford Univ., Corte Madera Creek, 51-08-21, P.S. Bartholomew (1/0 CAS). Santa Cruz Co.: 10 mi. S. Holy City, 68-04-27, A. & A. Gillogly (1/0 AG). Zayante Cr., 72-06-03, J.E. Cronin (1/3 JEC). Sonoma Co.: Duncan Mills, 69-07-21, P. Rubtzoff (3/0 CAS). Camp Meeker, 52-07-10, P.S. Bartholomew (1/2 CAS). Santa Rosa, 50-06-25, P.S. Bartholomew (0/1 CAS). Tehama Co.: Dead Mule Sprint, 3 km by road N. of Paskenta-Covelo Rd., 1570 m., 72-08-29, H.B. Leech (9/5 CAS). Trinity Co.: S. Fork Van Horn Cr. 2 mi. from mouth at upper Mad River, 3000', moss-edged rock pools in running stream, open area, 70-08-09, H.B. Leech (1/0 CAS). Van Horn Cr. 1.5 mi. above its mouth at upper Mad River, , 2850', clean water pools in gravel and stones of otherwise dry and shaded creek bed, 70-08-09, H.B. Leech (1/0 CAS). Kerlin Creek at Hyampon-Big Slide Rd., 68-07-23, H.B. Leech (1/0 CAS).

13. *Hydraena quadricurvipes* new species

Map: Figure 25D
Paratypes: 7
United States: Alabama: Marshall Co.: Grant, nr. River Cave, floor debris, light zone at entrance, 68-05-25, H.R. Steeves, Jr. (0/1 CFMNH). Georgia: Chattooga Co.: 2 mi. NE Subligna, outside Parker Cave, Berlese; #67 forest FM(HD) #67-121, 67-06-20, S. Peck & A. Fiske (1/0 CFMNH). Indiana: Brown Co.: Small stream nr. Needmore, 50-02-11, F.N. Young (1/0 PDP). Monroe Co.: Morgan-Monroe State Forest, 61-07-29, J.C. Schaffner (1/0 USNM; 1/1 PDP). Maryland: Montgomery Co.: Glen Echo, 22-06-24, J.R. Malloch (0/1 USNM).

15. *Hydraena pennsylvanica* Kiesenwetter

Map: Figure 25C
Specimens examined: 610
Canada: Ontario: Pr. Edw. Co., 23-05-01, J.F. Brimley (1/1 JFB). As above, 47-05-12 (1/0 JFB). No site, no date, no collr. (0/2 MU). Normandale, 31-06-04, W.J. Brown (1/0 CNC). Marmora, 52-07-22, J.R. Vockeroth (1/2 CNC). Ottawa, Black Rapids, 27-05-23, W.J. Brown (2/0 CNC). As above, 27-05-11 (0/1 CNC). Trenton, 04-11-23, Evans (0/1 CNC). Hastings, 05-05,15, Evans (0/1 CNC). Ventnor, 28-08-05, J.A. Adams (3/5 CNC). Ottawa, Black Rapids, 24-05-19, W.J. Brown (1/0 CAS). Quebec: La Trappe, no date, J. Ouellet (1/3 CSQ). Magog, 41-05-24, J.I. Beaulne (0/1 CSQ). Buffalo, 38-09-07, no collr. (1/1 USNM). Montreal, Berlese-clumps of moss and grass from swampy area overgrown with willows, 70-06-24, E.J. Kiteley (1/0 EJK). As above, 70-09-10 (0/1 EJK). As above, 70-08-01 (0/1 EJK). As above, 71-11-25 (1/0 EJK). Montreal, moss-Berlese, 70-11-15, E.J. Kiteley (2/4 EJK). Montreal, 70-11-19, E.J. Kiteley (0/1 EJK). As above, 69-09-07 (0/1 EJK). Montreal, 23-06-20, J. Ouellet (1/0 UM). As above, 05-08-10 (1/5 UM). As above, no date (0/1 UM). As above, 03-06-20 (0/1 UM). La Trappe, 44-07-09, J. Ouellet (1/1 UM). As above, 37-05-11 (1/2 UM). As above, 37-05-08 (0/1 UM). As above, 33-07-21 (1/0 UM). As above, 44-04-008 (0/1 UM). La Trappe, 43005-23, P. Leopold (1/0 UM). La Trappe, 46-07-29, J. Ouellet (1/0 UM). As above, 45-08-09 (0/1 UM). As above, 35-08-08 (1/0 UM). La Trappe, 37-05-08, P. Leopold (2/3 UM). Rigaud, 37-07-31, A. Robert (1/2 UM). As above, 39-05-29 (0/1 UM). Berthierville, 50-05-27, A. Robert (0/1 UM). As above, 69-07-30, (0/1 UM). Cascapedia, 33-08-17, W.J. Brown (3/0 CNC). Aylmer, 29-05-11, W.J. Brown (0/1 CNC). Fairy Lake, 27-10-02, W.J. Brown (1/0 CNC). As above, 27-08-07 (1/0 CNC). As above, 27-05-17 (1/0 CNC). As above, 27-09-09 (0/1 CNC). Kazubatua, 31-09-18, W.J. Brown (2/3 CNC). As above, 27-06-06 (1/0 CNC). As above, 28-08-26 (1/2 CNC). Duparquet, Duparquet Lake, 34-11-01, G. Stace Smith (1/0 CAS). Duparquet, 35-08-02, G. Stace Smith (0/6 CAS). As above, 35-08-26 (0/1 CAS). La Trappe, 37-05-12, J. Ouellet (2/3 CAS). Kazubazua, 28-08-26, W.J. Brown (0/1 CAS). Wakefield, 28-05-05, W.J. Brown (0/1 CAS).

United States: Connecticut: Litchfield Co.: Litchfield, 22-04-28, L.B. Woodruff (1/0 AMNH). Litchfield, stoney brook, 25-09-29, L.B. Woodruff (1/0 AMNH). Lake Co.: Volo, Sayer Bog (Volo Bog), 66-10-01 (3/3 WRS). As above, 61-03-16 (1/1 WRS). Tamarack Bog, 46-07-05, H.S. Dybas (1/0 CFMNH). Volo Bog, 68-03-29, A. Smetana (1/0 CNC). Unspecified Co.: No site, no date, no collr. (2/1 INHS). Maryland: Unspecified Co.: No site, no date, no collr. (1/4 UMA). Massachusetts: Bristol Co.: Dighton, no date, no collr. (0/1 MCZ). Swansea, 11-05-20, N.S. Easton (0/1 MCA). Fall River, 02-07-27, N.S. Easton (0/2 UMI). Essex Co.: Lawrence, no date, Crew (0/1 CU). Lawrence, no date, no collr. (4/1 CMNH). Hampden Co.: W. Springfield, 03-08-04, F. Knab (1/0 USNM). Hampshire Co.: Northampton, UV light, 71-06-12, E.J. Kiteley (0/1 EJK). Middlesex Co.: Framingham, 34-12-02, N.M. Downie (1/0 NMD). Framingham, 34-11-17, N.M. Downie (0/1 NMD). Framingham, 07-08-18, C.A. Frost (0/2 INHS). Natick, no date, F.E. Winters (2/0 CU). Wayland, sifting moss, no date, F.E. Winters (1/0 CU). Framingham, no date, C.A.

Frost (0/1 CU). Framingham, 36-09-07, C.A. Frost (1/0 UCD). Framingham, 07-09-07, no collr. (1/2 CNC). Sherborn, 21-10-23, C.A. Frost (1/0 MCZ). Lowell, no date, no collr. (1/1 MCZ). Norfolk Co.: Brookline, 1895-03-24, F.C. Bowditch (2/1 MCZ). Suffolk Co.: Cambridge, no date, Hubbard and Schwarz (1/1 USNM). Cambridge, no date, no collr. (0/2 MCZ). Unspecified Co.: No site, no date, no collr. (1/1 MCZ). Michigan: Cheboygan Co.: Nigger Creek, 52-07-14, P.J. Spangler (3/0 USNM). Livingston Bog, 52-07-14, P.J. Spangler (1/0 USNM). Bryants Bog, 52-07-16, P.J. Spangler (1/0 USNM). Mud Lake Bog, 66-07-24, T. Schuh, E. Evans (0/1 WRS). Clinton Co.: Rose Lake, 66-03-02, no collr. (4/0 JS). Delta Co.: Escanaba, 58-05-31, E.J. Kiteley (0/1 EJK). Eaton Co.: Grand Ledge, no date, Hubbard and Schwarz (0/1 USNM). Emmet Co.: Bryant Road, 52-07-25, P.J. Spangler (3/1 USNM). 4 mi. E. Levering, 52-07-05, P.J. Spangler (1/1 USNM). Maple River, 52-08-08, P.J. Spangler (0/1 USNM). Ingham Co.: Ag. Coll., no date, no collr. (1/0 USNM). Lansing, no date, no collr. (0/1 MCZ). Lapper Co.: Lapeer St. Game Area, Cedar Lake Bog, 63-08-25, W. Suter and R.C. Graves (2/3 CFMNH). Livingston Co.: E.S. George Reserve, 50-04-17, I.J. Cantrall (2/2 CAS). As above, 52-07-22, F.N. Young (35/50 UMI). As above, 51-04-08, I.J. Cantrall (46/60 UMI). As above, 50-04-17, F.N. Young (6/5 FNY). As above, 51-07-09, I.J. Cantrall and F.N. Young (1/0 FNY). As above, 50-06-10, F.N. Young (0/2 FNY). As above, 51-06-22, F.N. Young (0/1 FNY). As above, 51-07-08, F.N. Young (0/1 FNY). As above, 51-08-30 (0/1 FNY). As above, 52-06-21 (0/1 FNY). As above, 51-05-18 (1/1 BM). E.S. George Reserve, Big Cassandra Bog, 58-10-19, M. Englemann (1/0 WRS). Luce Co.: Dollarville, 64-07-31, R.B. Wilson (1/1 WRS). Midland Co.: No site, 51-07-10, R.R. Dreisbach (1/0 UMI). Shiawassee Co.: T5N, R1E Sec 20-29, 67-06-04, T. Schuh and T. Hlavac (1/0 JS). As above, 67-05-21 (1/0 JS). Washenah Co.: Whitmore Lake, sweeping grass in swamp, 55-05-14, G.H. Nelson (0/1 WRS). Washtenaw Co.: Ann Arbor, 40-09-25, R. Kenk (1/0 CAS). Wayne Co.: Detroit, no date, Hubbard and Schwarz (3/2 USNM). Detroit, no date, no collr. (2/0 CMP). Unspecified Co.: No site, no date, no collr. (1/0 USNM). Minnesota: Cass Co.: Leech Lake, 64-08-21, P.H. Arnaud, Jr. (1/0 CAS). Mille Lacs Co.: 2 mi. E. and 2 mi. S. Onamia, from leaf litter using a Berlese funnel, 65-06-19, P.J. Clausen (40/8 UMA). New Jersey: Bergen Co.: Westwood, no date, no collr, (6/7 AMNH). Hackensac, no date, Wintersteiner (3/0 CU). Cape May Co.: Petersburg, no date, no collr. (0/1 MCZ). Morris Co.: Troyhills, 66-08-18, D.C. Miller (10/8 DCM). Newfoundland, no date, no collr. (0/1 AMNH). Unspecified Co.: No site, no date, no collr. (1/1 CU). New York: Albany Co.: Rennselaerville: Huyck Preserve, litter in open area of bay, shore of the Myosotis, 74-08-27, W.R. Suter (6/2 USNM). As above, Fir buttress nr. bay (2/1 USNM). As above, lake shore litter under fern (6/0 USNM). As above, lake shore litter under mint and jewelweed (1/1 USNM). As above, litter under fern and jewelweed, shore of Lake Myosotis, in protected southern bay, 74-08-24 (0/1 USNM). S. Westerlo: Bear Swamp, sphagnum, 74-08-14, W.R. Suter (1/1 USNM). Bronx Co.: Mosholu, no date, no collr. (1/0 CU). Erie Co.: 4 mi. N. Alden, moss on Willow buttress, wamp, dried, 74-08-07, W.R. Suter (0/1 USNM). Monroe Co.: Rochester, no date, K.W. Cooper (0/1 FNY). Niagara Co.: Olcott, 21-07-06, H. Dietrich (0/1 CU). Onondaga Co.: No site, 41-10-15, N.M. Downie (3/2 NMD). Richmond Co.: Staten Island, no date, no collr. (1/4 CAS; 8/5 CU). St. Lawrence Co.: Rossie, 63-08-19, N.M. Downie (1/0 NMD). Suffolk Co.: Long Island, no date, Wintersteiner (3/1 CU). Tompkins Co.: Ithaca, 15-04-14, no collr. (1/0 CU). As above, 15-04-29 (1/1 CU). Ringwood Res., 64-04-18, P. Wood (1/0 CU). Ithaca, Ringwood, no date, H. Dietrich (0/4 CU). Ulster Co.: Ludlow, no date, no collr. (1/0 CAS). Unspecified Co.: No site, no date, no collr. (1/0 USNM). Arnot Forest, no date, R.D. Harwood (1/0 CU). Pennsylvania: Unspecified Co.: No site, no date, no collr. (1/0 AMNH). Rhode Island: Washington Co.: Rockville, sphagnum, Eel Pond (bog), 61-07-04, Suter, Wagner and Reichle (0/1 WRS). Vermont: Bennington Co.: No site, no date, no collr. (1/0 USNM; 1/0 CU). Lamoille Co.: Lake of the Clouds on Mount Mansfield, 59-06-19, F.N. Young (1/0 FNY). Windsor Co.: Woodstock, no date, no collr. (0/2 CU). Unspecified Co.: No site, no date, no collr. (1/0 USNM: 1/0 CAS). Virginia: Highland Co.: Head waters, Colombia Union College Field Station, 66-07-27, P.J. Spangler (4/5 USNM). Wisconsin: Kenosha Co.: Salem, Van Halter Bog, sphagnum, 67-09-16, W.R. Suter (1/0 WRS). Salem, Van Halter Bog, Sphagnum, 69-09-01, W.R. Suter (2/4 USNM). 3 mi. NW Somers, mosses, Holmes Woods, 74-04-17 (0/1 USNM). Salem, Van Halter Bog, Sphagnum, 74-02-19, W.R. Suter (0/1 USNM). 3 mi. NW Somers, Holmes Woods, mosses, 73-03-28, W.R. Suter (2/3 USNM). Marinette Co.: Harvey Cr., 70-08-24, John L. Hellman (0/1 JLH). Marquette Co.: Endeavor, Sphagnum bog, 61-04-10, W.R. Suter (2/2 WRS). Sauk Co.: Sauk City, 1899-08-09, no collr. (1/0 US). Sauk City, 1899-08-05, no collr. (1/0 MCZ). Waushara Co.: S. Br. Wedde Cr., 70-08-13, John L. Hellman (1/0 JLH). Soules Cr., 70-08-13, John L. Hellman (0/1 JLH). Unspecified Co.: No site, no date, no collr. (1/0 CU; 0/3 USNM).

16. *Hydraena ancylis* new species

Map: Figure 25D

Paratypes: 21

United States: Indiana: Monroe Co.: Bloomington, Z. Pond 144a, 61-07-01, D.P. Wooldridge (5/1 DPW). Beech Flats N. of Bloomington, 55-07-12, F.N. Young (1/0 FNY). Louisiana: Madison Co.: Tallulah, 30-12-08, P.A. Glick (1/0 USNM). Missouri: Boone Co.: Silver Fork St., St. 5, 76-07-16, no collr. (1/1 USNM). Pennsylvania: York Co.: 5 mi. NW Davidsburg, 62-07-07, P.J. Spangler (2/5 USNM). Same, 72-09-03, P.J. Spangler & P.D. Perkins (1/0 PDP). Texas: Hardin Co.: Saratoga, Ghost Road, Sphagnum, 72-06-11, W. Suter (1/2 PDP).

17. *Hydraena vandykei* d'Orchymont

Map: Figure 23C

Specimens examined: 378

Canada: British Columbia: Victoria, Vancouver, no date, no collr. (1/3 MCZ).

United States: California: Alameda Co.: San Ramon Creek, 51-07-12, P.S. Bartholomew (1/0 CAS). Dimond, 60-05-15, F.E. Blaisdell (1/0 CAS). Contra Costa Co.: Berkeley, 19-11-11, H. Dietrich (10/16 CU). Perkins Gulch, 7 mi. SE Clayton, 66-07-22, J. Doyen (27/26 UCB). Hills back of Oakland, 08-06-07, no collr. (1/0 CAS). Berkeley, 47-10-28, D. Giuliani (1/0 CAS). Mt. Diablo, 19-09-21, J.O. Martin (1/0 CAS). Humboldt Co.: Conley Creek, 0.8 mi. SE Blocksburg, 1350', 68-07-19, H.B. Leech (1/5 CAS). N. Fork Yager Cr. at Bridgeville-Kneeland Rd., 1300', 66-08-08, H.B. Leech (0/2 CAS). Toss-up Creek, confluence with Redwood Creek, 2.5 mi. N. of road to Hoopa, ca 650', 70-08-13, H.B. Leech (6/4 CAS). Mill Cr., 7/5 mi. S. of Bridgeville, 1200', 68-07-19, H.B. Leech (0/3 CAS). Stream under Bair Rd., trib. to Pine Cr., W. of Hoopa, 3300', 70-08-14, H.B. Leech (0/1 CAS). N. Fork Mad River at Route 299, NE of Korbel, 525', 70-08-30, H.B. Leech (1/0 CAS). Burr Cr., 3 mi. S. Bridgeville, 1200', 68-07-19, H.B. Leech (1/0 CAS). Lake Co.: No site, no date, no collr. (0/1 USNM). Barlett Sprs., no date, no collr. (0/1 CU; 0/1 MCZ). Lucerne, foul pool, dried bed of Cottage City Creek, 55-07-30, H.B. Leech (8/19 CAS). Headwaters, Long Valley Cr., 3750' 55-08-01, H.B. Leech (0/1 CAS). Middle Cr., 5 mi. N. Upper Lake, 55-08-04, H.B. Leech (0/1 CAS). Scott Cr., 2.75 mi. S. Lower Blue Lake, 55-08-05, H.B. Leech (0/1 CAS). Kelsey Cr., Kelseyville, 49-05-29, H.B. Leech (0/2 CAS). Rice Fork of Eel River at Crabtree Hot Spring, 57-08-09, H.B. Leech (1/0 CAS). 6.9 mi. N. Middletown, on hwy. 29, R.A. Badger Ranch, ephemeral stream, 55-02-20, H.B. Leech (1/2 CAS). Creek behind Cottage City Resort, 53-07-05, H.B. Leech (1/0 CAS). Los Angeles Co.: Big Rock Cr., San Gabriel Mts., 59-03-31, P.H. Raven (1/0 CAS). Pasadena, 17-01-28, J.O. Martin (1/2 CAS). As above, 17-09-06 (0/2 CAS). As above, 18-09-02 (2/2 CAS). San Gabriel Canyon, 46-04-16, G.P. Mackenzie (1/0 UCR). Mts. nr. Claremont, no date, no collr. (2/2 CMP). Claremont, no date, C.F. Baker (0/4 CFMNH). Pomona Mts., no date, no collr. (1/1 MCZ). Los Angeles, no date, no collr. (0/2 MCZ). Mts. nr. Claremont, no date, Baker (0/1 MCZ). No site, no date, Koebele (1/0 USNM). Marin Co.: No site, 19-11-08, H. Dietrich (0/1 USNM). No site, 19-11-08, H. Dietrich (1/4 CU). Fairfax, no date, F.E. Blaisdell (1/2 CAS). Mill Valley, 51-07-09, P.S. Bartholomew (1/0 CAS). Mill Valley, Cascade Cr., 52-05-11, H.B. Leech (1/0 CAS). As above, 52-05-13 (1/1 CAS). As above, 52-03-29, H.B. Leech (0/1 CAS). L. Lagunitas, 58-12-23, D.C. Rentz (0/1 CAS). Mill Valley, Falls Cr., 57-04-25, H.B. Leech (1/0 CAS). Lagunitas Cyn., 19-11-08, J.O. Martin (2/2 CAS). Lake Lagunitas, 19-11-01, no collr. (1/2 CAS). Carson Ridge, Woodacre, 56-01-09, H.B. Leech (4/3 CAS). Tocaloma, pool at culvert, 68-05-04, H.B. Leech (8/9 CAS). Mariposa Co.: Miami Ranger Station, 5000', 42-07-06, H.P. Chandler (0/1 CAS). Mendocino Co.: Eel River R.S., 53-08-14, P.S. Bartholomew (1/0 CAS). Hendy Woods S.P., 58-06-14, L.N. & C.J. Bell (1/0 CAS). Mill Creek just W. of Mailliard, Redwoods State Park, 64-09-06, H.B. Leech (2/0 CAS). Twin Rocks, 29-07-10, no collr. (4/8 CAS). Williams Creek at Covelo-Paskenta Rd., 68-07-17, H.B. Leech (0/1 CAS). Beebe Cr., 50-09-05, H.B. Leech (0/1 CAS). Eel River N. of Potter Valley, 50-09-02, H.B. Leech (0/1 CAS). Mendocino, 57-07-21, J.R. Helfer (0/1 CAS). Rancheria Cr., 5.5 mi. SE Boonville, 50-06-15, H.B. Leech (0/1 CAS). Bloody Run Creek, 7 mi. E. of route 101, on Longvale-Covelo Road, 1100', 68-07-18, H.B. Leech (3/4 CAS). Parson Creek, 4.5 mi. NE Hopland, 64-06-30, H.B. Leech (9/6 CAS). Monterey Co.: Escondido, 73-05-19, J.E. Cronin (1/1 JEC). Napa Co.: 6 mi. NE Rutherford, 71-07-16, P.D. Perkins (3/6 PDP). San Bernardino Co.: L. Arrowhead, 43-07-26, G.P. Mackenzie (1/1 AMNH). L. Arrowhead, 43-07-25, G.P. Mackenzie (1/0 UA). San Mateo Co.: No site, no date, A. Koebele (1/0 USNM). La Honda, 26-07-14, P.S. Bartholomew (0/1 CAS). Santa Barbara Co.: Santa Barbara 2300', no date, F. Winters (2/1 CU). Santa Inez Mts., no date, no collr. (0/1 CAS). Santa Cruz Island, 70-09-19, P.D. Perkins (1/0 PDP). Santa Clara Co.: Los Gatos, no date, Hubbard & Schwarz (0/1 USNM). Los Gatos, 67-10-27, A. & A. Gillogly (1/0 AG). Alma, 27-08-01, J.O. Martin (1/3 CAS). Santa Cruz Co.: Santa Cruz Mts., no date, no collr. (1/3 CAS). Santa Cruz Mts., no date, A. Koebele (0.2 USNM). Sonoma Co.: Duncan Mills, no date, no collr. (0/2 USNM). Duncan Mills, 08-07-14, F.E. Blaisdell (/3 CU). Calistoga, 34-06-12, Bryant (3/5 CAS). Rio Nido, 47-07-06, D. Giuliani (0/1 CAS). Duncan Mills marsh, 69-07-21, P. Rubtzoff (0/2 CAS). Duncan Mills, 08-07-14, no collr. (3/1 CFMNH). Austin Cr., 2 mi. S. Cazadero, 54-10-30, H.B. Leech (1/0 CAS). Mark West Cr. at Calistoga Rd., ca 4 mi. S. Petrified Forest, 63-07-08, H.B. Leech (4/2 CAS). Camp Meeker, 52-07-10, P.S. Bartholomew (6/2 CAS). Guerneville, 08-07-14, F.E. Blaisdell (0/1 CAS). As above, 08-07-23, (1/0 CAS). Tehama Co.: Dead Mule Spr., 3 km by road N. of Paskenta-Covelo Rd., 1570 m, 72-08-29, H.B. Leech (1/1 CAS). Trinity Co.: Van Horn Cr., 1.5 mi. above its mouth at upper Mad River, clear water pools in gravel and stones of otherwise dry and shaded creekbed, 2850', 70-08-09, H.B. Leech (3/9 CAS). Salt Cr. at Peanut, 60-08-01, H.B. Leech (0/1 CAS). Mad River at route 36, nr. Mad River Park, 68-07-20, H.B. Leech (1/1 CAS). Hayfork Cr., 1.5 mi. S. of its East Fork, on Solidage flowers, 838 m, 72-08-08, H.B. Leech (0/1 CAS). Hayfork Cr. at Hayfork-Wildwood Road, 70-08-11, H.B. Leech (2/1 CAS). S. Fork Van Horn Creek, 2 mi. from mouth at Upper Mad River, moss-edged rock pools in running stream, open area, 70-08-09, H.B. Leech (4/1 CAS). Bridge Gulch Cr. at Natural Bridge, 7.5 mi. airline N. Wildwood, 70-08-10, H.B. Leech (2/0 CAS). Mad River, 6 mi. S. Ruth, 60-07-31, H.B. Leech (4/2 CAS). Unspecified Co.: No site, no date, no collr. (1/0 CFMNH).

18. *Hydraena sierra* new species

Map: Figure 23F

Paratypes: 16

United States: California: Fresno Co.: Stream from E. entering S. fork San Joaquin River, at gauging station by N. end Jackass Dike, N. of Florence Lake, 7200', 71-08-31, H.B. Leech (0/6 CAS). Madera Co.: Same data as Holotype (5/2 CAS). Nevada Co.: Graniteville, 52-08-22, P.S. Bartholomew (1/0 CAS). Tulare Co.: Sequoia Nat. Park, no date, F.E. Winters (1/0 CU). Oregon: Multnomah Co.: Portland, no date, Hubbard & Schwarz (1/0 USNM).

19. *Hydraena leechi* new species

Map: Figure 34A

Paratypes: 180

Mexico: Chihuahua: 30 mi. NW Chihuahua, Majalca Rd., 5500', 61-04-14, Howden and Martin, (1/0 CNC). Tamaulipas: 2 mi. SW Ciudad Victoria, stream in desert, 74-07-27, M.E. & P.D. Perkins (1/0 PDP).

United States: Arizona: Cochise Co.: Sunnyside Cyn., W. side Huachuca Mts., 6000', 52-08-04, H.B. Leech, (14/5 CAS). E. of Cochise Stronghold, 70-09-18, P. Bartholomew, (0/1 CAS). Dry Cn. Sands Ranch, SE end Whetstone Mts., 52-08-10, H.B. Leech, (2/2 CAS). Bisbee, 33-03-25, Bryant, (0/1 CAS). Hot Springs, no date, Barber and Schwarz, (0/3 USNM). Chiric. Mts., no date, Hubbard & Schwarz, (0/1 USNM). Chiric. Mts., no date, no collr. (0/2 CU). Huachuca Mts., Garden Canyon, 50-06-23, C.P. Alexander, (0/1 MCZ). Cochise Stronghold, black light, 71-09-25, D.S. Chandler, (1/0 UA). Coconino Co.: Oak Cr. Canyon, Midgley Bridge, 52-08-25, H.B. Leech, (23/21 CAS). Gila Co.: Globe, 48-10-13, F.H. Parker, (4/2 CAS). As above, (0/1 UA). Globe, Pinal Creek, 4000', 53-04-24, A. & H. Dietrich, (1/0 CU). Pima Co.: Santa Catalina Mts., Bear Canyon HH. mi. 11, B.L. trap. 59-07-09, F.G. Werner, K.W. Radford, & G.A. Samuelson, (0/1 UA). Santa Catalina Mts., Pepper Sauce Cyn., B.L. trap, 61-07-08, P.H. Johnson, (0/1 UA). Sabino Cyn., Catalina Mts., 55-11-27, G.D. Butler & F.G. Werner (1/1 UA). 2 mi. NW Arivaca, in moss and grass roots along stream, 72-01-03, D.P. Levin & D.S. Chandler, (2/3 UA). 2 mi. NW Arivaca, under bark of dead cottonwood, 72-03-29, D.S. Chandler, (1/1 UA). As above, in moss and grass roots along stream, 72-02-06, (0/1 UA). As above, collected along creek edge, 71-11-13, (0/3 UA). Pinal Co.: Riverside, no date, Wickham, (1/1 USNM). Santa Cruz Co.: Nogales, no date, no collr., (4/3 CAS). Sycamore Cyn., pools, cr. bed below Yank's Spring, Tumacacori Mts., ca 4000', 65-07-27, H.B. Leech, (2/1 CAS). Santa Rita Mts., Madera Cyn., 70-09-01, D.G. Marqua & P.H. Sullivan, (1/1 PDP). Nogales, 06-09-07, F.W. Nunenmacher, (1/1 CU). As above, (1/1 CFMNH). 15 mi. NW Nogales, Pena Blanca Lake, 61-05-26, Howden & Martin, (3/2 CNC). Sycamore Cyn. nr. Ruby, 55-11-20, F.G. Werner & G.D. Butler, (3/6 UA). Florida Cyn., Santa Rita Mts., 59-04-19, F.G. Werner, (1/0 UA). Oklahoma: Johnston Co.: Pennington Cr., Tishomingo, 62-06-30, H.P. Brown, (1/1 PDP). Pennington Cr., Devil's Den, 72-07-25, H.P. Brown, (0/1 PDP). Murray Co.: Honey Cr., Turner Falls, 68-08-23, H.P. Brown, (0/1 PDP). Texas: Brewster Co.: Big Bend N. P., Pulliam Canyon, 45-6500', 59-05-12, W.R.M. Mason, (4/0 CNC). Big Bend N.P., Boot Spring, 7000', 59-05-18, Howden and Becker, (3/1 CNC). Big Bend N.P., Glenn Springs, 72-03-23, H.P. Brown, (1/1 PDP). Culberson Co.: 2.5 mi. E. of Nickel Creek Sta., 52-09-02, B. Malkin & V.E. Thathcre, (1/0 CFMNH). Jeff Davis Co.: Limpia Creek Canyon, Davis Mts., 52-09-04, B. Malkin, (14/17 CFMNH). Limpia Creek, 74-06-26, H.P. Brown (0/1 PDP).

20. *Hydraena breedlovei* new species

Map: Figure 166

Paratypes: 34

Mexico: Durango: Same data as Holotype (14/18 CAS). 9 mi. E. Los Bancos, ca 90 mi. W. Durango, stream, pine forest meadow, 74-07-17, M.E. & P.D. Perkins (1/0 PDP). 1 mi. E. Los Bancos, ca 98 mi. W. Durango, stream in pine forest, 74-07-17, M.E. & P.D. Perkins (1/0 PDP).

21. *Hydraena arizonica* new species

Map: Figure 34A

Paratypes: 47

Mexico: Durango: Los Altares, ex under stones in small creek in moutains, 2500 m, 74-10-10, H. & B. Reichardt (1/0 MSP).

United States: Arizona: Cochise Co.: Sunnyside Cyn., W. side Huachuca Mts., 6000', 52-08-04, H.B. Leech (12/5 CAS). Chiricahua Mts., above Herb Martyr, 74-06-22, H.P. Brown (2/1 PDP). Rustler's Park, 56-07-08, F.N. Young

(4/1 FNY). Santa Cruz Co.: Santa Rita Mts., Madera Cyn., 6200', H.B. Leech (2/4 CAS). Madera Cyn., collected along creek edge, 71-11-20, D.S. Chandler, (5/8 UA). Santa Rita Mts., 34-10-21, Bryant (0/1 CAS). Santa Rita Mts., no date, Hubbard & Schwarz (1/0 USNM).

22. *Hydraena bituberculata* new species

Map: Figure 34B

Paratypes: 52

United States: Arizona: Cochise Co.: Southwest Research Station, 64-10-24, P.H. Arnaud, Jr. (5/4 CAS). 3.5 mi. SW Portal, Chiricahua Mts., 5000', 52-08-13, H.B. Leech (0/1 CAS). Chiric Mts., no date, Hubbard & Schwarz (9/2 USNM). Chiricahua Mts., above Herb Martyr, 74-06-22, H.P. Brown (1/1 HPB). Rustler's Park, spring, 56-07-08, F.N. Young (15/11 FNY). Chiricahua Mts., Rucker Cyn., 1730-1760 m., stream banks, 76-07-22, P.M. Hammond (2/0 BMNH). New Mexico: Dona Ana Co.: Organ Mts., no date, no collr. (1/0 CU).

26. *Hydraena alternata* new species

Map: Figure 34B

Paratypes: 27

Mexico: Durango: 9 mi. E. Los Bancos, ca 90 mi. W. Durango, stream, pine forest meadow, 74-07-17, M.E. & P.D. Perkins (0/1 PDP). Los Altares, ex under stones in a small creek in the mountains, 2500 m, 74-10-10, H. & B. Reichardt (8/8 MSP; 5/5 PDP).

42. *Hydraena ozarkensis* new species

Map: Figure 42B

Paratypes: 61

United States: Indiana: Monroe Co.: Stephens Creek in T-9-N, R-1-E, Sec 20, 704, 50-06-23, F.N. Young (1/4 FNY). Parke Co.: 4 mi. W. Rockville, Hajji Hollow, air-4:45-5:15 PM, 71-08-14, H.S. Dybas (1/1 CFMNH). Missouri: Boone Co.: 5 miles S. Columbia, 54-04-19, P.J. Spangler (0/1 USNM). Cape Giarardeau Co.: Cape Girardeau, La Croix Creek, 53-09-11, P.J. Spangler (3/8 USNM). Cape Girardeau, 54-05-10, D. Stout (1/0 USNM). Dallas Co.: Bennett Springs, 56-07-07, P.J. Spangler (1/6 USNM). Greene Co.: 3 mi. E. Springfield, Sac River, 56-04-13, P.J. Spangler (3/5 USNM). McDonald Co.: Rush Creek, 2 mi. E. Jane, 72-08-08, P.D. Perkins (4/8 PDP). Ripley Co.: Doniphan, 56-04-23, no collr. (0/2 USNM). Oklahoma: Wagoner Co.: 14 mi. E. Wagoner, 64-06-20, P.J. Spangler (5/5 USNM). Tennessee: Humphreys Co.: Near Buffalo, 62-07-20, F.N. Young (0/2 FNY).

46. *Hydraena particeps* new species

Map: Figure 59

Paratypes: 22

Grenada: Mount Gay Est. (Leeward side), no date, H.H. Smith (2/1 BMNH).

Honduras: Choluteca: 10 mi. W. Choluteca, 65-07-29, P.J. Spangler (1/0 PDP).

Panama: Panama: Madden L. near dam, pocket of damp leaves in dry streambed, 59-02-15, H.S. Dybas (4/4 CFMNH). Canal Zone: Albrook Forest Site, B-light, 68-01-31, R.S. Hutton (2/1 PDP).

Trinidad: Base of Galeota Pt., 35-09-20, N.A. Weber (2/2 MCZ).

Venezuela: Portuguesa: Guanare, 57-09-10, B. Malkin (1/2 CAS).

48. *Hydraena guadelupensis* d'Orchymont

Map: Figure 59

Specimens examined: 59

Costa Rica: Reventazon, Hamburg Farm, sifted from swamp litter, 33-08-07, F. Nevermann (1/0 USNM).

Jamaica: Moneague, 34-08-26, Darlington (1/2 MCZ). Ocho Rios, 34-08-20, Darlingon (2/4 MCZ). Porus, sta. 414, flying at dusk, 37-02-23, Chapin & Blackwelder (14/28 USNM). Milk River, 37-02-25, Chapin and Blackwelder (0/1 USNM). Bog Walk, 37-02-02, Chapin & Blackwelder (0/3 USNM). Hope River, 18-05-26, M. Cameron (1/0 BM). St. Catherine, Bushy Park, 47-02-09, ex. small pool in narrow gully, G.B. Thompson (1/1 IOJ).

Virgin Islands: St. John, Cinnamon Bay, spring, 63-01-23, P.J. Spangler & D. Zani (15/45 USNM).

49. *Hydraena spangleri* new species

Map: Figure 56B

Paratypes: 150

United States: Florida: Alachua Co.: Wacahootee, 39-10-12, F.N. Young (1/1 FNY). Island Grove at Orange Lake, debris at swamp edge, yellow poplar, palms, 65-08-22, H.R. Steeves (1/0 CFMNH). Collier Co.: Monroe Sta., 2.5 mi. E., hardwood hammock along Tamiami Trail, 66-04-07, J. Wagner (10/5 CFMNH). Dade Co.: Everglades Natl. Park, Palm Vista Hammock, 65-08-27, W.R. Suter (3/0 CFMNH). Everglades Natl. Park, Mahogany Hammock, Palmetto-Mahogany Swamp, 65-06-18, W.R. Suter (7/9 CFMNH). Highlands Co.: Venus, 4 mi. W., Fisheating Creek, under water hyacinth, 73-12-30, W.R. Suter (2/3 USNM). Venus, 4 mi. W., Fisheating Creek, grassy compost mixed with Cypress needles on bridge approach, 65-08-25, W.R. Suter (3/0 CFMNH). Hammock State Park, Magnolia buttress, 66-04-06, W.R. Suter (1/0 CFMNH). Jackson Co.: Marianna, 3 mi. NW., litter in sinkhole, 68-09-08, S. Peck (1/0 CFMNH). Leon Co.: Chaires, 65-08-29, W.R. Suter (0/1 CFMNH). Sarasota Co.: Myakka River State Park, Fla. rt. 72, Palmetto-oak pocket, 65-06-16, W.R. Suter (2/0 CFMNH). Volusia Co.: lake Helen (vicinity), berlese, litter, 69-04-10, W.R. Suter (3/3 CFMNH). Georgia: Glynn Co.: St. Simon's Island, Brunswick, 77-06-19, Hoffman (2/0 PDP). Louisiana: Madison Co.: Tallulah, no date, no collr. (1/0 PDP). Maryland: Montgomery Co.: Plummer's Island, 60-06-06, P.J. Spangler (16/28 USNM). As above, 60-09-01, (3/3 USNM). As above, 72-04-19, (1/0 USNM). C. & O. Lock at Plummer's Island, 60-06-29, P.J. Spangler (1/3 USNM). As above, 61-06-07, (9/16 USNM). Talbot Co.: Easton, 73-07-29, Spangler & Cross, (4/3 USNM). Easton, Seth State Forest, 76-05-13, Spangler et al. (30/48 USNM). Mississippi: George Co.: Pool 6 mi. W. Pascagoula R., 60-06-17, F.N. Young (1/2 FNY). Oklahoma: Carter Co.: 5 mi. E., stump berlese, 68-07-09, W. Suter (1/0 USNM). South Carolina: Bramberg Co.: No site, 66-11-20, R.E. Widdows (1/1 CFMNH). Berkeley Co.: No site, 66-10-13, R.E. Widdows (2/1 CFMNH). Charlestown Co.: No site, 66-10-13, R.E. Widdows (1/0 CFMNH). Sumter Co.: Sumter, 66-10-29, R.E. Widdows (1/0 CFMNH). Texas, Hardin Co.: Saratoga, Ghost Road, sphagnum, 72-06-11, W. Suter (1/2 USNM). Virginia: Hampton Co.: Fort Monroe, no date, no collr (0/1 PDP).

50. *Hydraena punctata* LeConte

Map: Figure 42B

Specimens examined: 24

United States: Connecticut: Fairfield Co.: No site, no date, no collr. (2/0 CU). Massachusetts: Middlesex Co.: Drac, 1890-08-02, no collr. (2/2 CMP; 1/2 MCZ). Drac, no date, no collr. (1/1 MCZ; 0/1 BMNH). Tyngsboro, no date, no collr. (2/1 MCZ; 0/1 BMNH). Unspecified Co.: No site, no date, no collr. (2/1 CMP; 0/1 MCZ). New Jersey: Bergen Co.: Westwood, no date, no collr. (0/1 AMNH). New York: Tompkins Co.: Ithaca, Fall Creek, Stewart Park, A. d'Orchymont (0/1 ISNB). Ulster Co.: Esopus, no date, no collr. (1/0 CU). Unspecified Co.: Totowa, no date, Wintersteiner (1/0 CU).

51. *Hydraena oblio* new species

Map: Figure 59

Paratypes: 13

Guatemala: Baja Verapaz: Same data as Holotype (2/2 PDP). Chiquimula: 4 mi. N. Quezaltepeque, madicolous habitat, 74-06-17, M.E. & P.D. Perkins (0/2 PDP). Huehuetenango: 6 mi. NW Huehuetenango, stream in oak-pine, 74-06-29, M.E. & P.D. Perkins (0/1 PDP).

Mexico: Chiapas: Jct. Rts. 190 & 195, 69-06-11, J.M. Cambpell (3/3 CNC).

57. *Hydraena prieto* new species

Map: Figure 42A

Paratypes: 29

Mexico: Durango: Same data as Holotype (16/10 PDP). Los Altares, 2500 m, ex. under stones in a small creek in the mountains, 74-10-10, H. & B. Reichardt (1/1 MSP). Jalisco: 7 mi. S. Mazamitla, 48-12-01, H.B. Leech (1/0 CAS).

61. *Hydraena cuspidicollis* new species

Map: Figure 42A

Paratypes: 72

Mexico: Colima: 29 mi. NE (by road) of Colima, 48-12-03, H.B. Leech (0/18 CAS). Jalisco: 7 mi. S. Mazamitla, stream in pine forest, 74-07-15, M.E. & P.D. Perkins (0/1 PDP). Mexico: 11 mi. S. Valle de Bravo, stream in deciduous-pine forest, 74-07-12, M.E. & P.D. Perkins (0/20 PDP). San Antonio, 8000-10,000', 66-10-11, H.P. Brown (0/22 HPB). Temescaltepec, Real de Arriba, 6-7000', 34-07-01, H.E. Hinton & R.L. Usinger (0/3 BMNH). As above, 1932 (0/1 BMNH). Oaxaca: Same data as Holotype (2/4 PDP). Veracruz: 1.2 mi. S. Huatusco, cloud forest litter, berlese, 1344 m, 68-08-02, S. & J. Peck (0/1 CNC).

68. *Hydraena mexicana* new species

Map: Figure 42A

Paratypes: 5

Mexico: Chiapas: Same data as Holotype (1/0 PDP). San Luis Potosi: Same data as Allotype (2/0 CAS). Veracruz: Cordoba, no date, A. Fenyes (1/1 CAS).

74. *Hydraena hyalina* new species

Map: Figure 92A

Paratypes: 70

Brazil: Bahia: 5 km W. Ilheus, 69-07-04, P. & P. Spangler (1/3 USNM).

Guyana: British Guiana, nr. Lethem, Rupununi, weeds on mud of drying pond in Savannahs, 61-02-02, T. Clay (5/3 BMNH). Brit. Guiana, Kanuku Mts., Rupununi, debris edge of forest creek, 61-02-21, T. Clay (1/3 BMNH).

Venezuela: Guarico: 15 km S. Calabozo, coll'd. in Lago de Los Patos, 69-02-09, P. & P.J. Spangler (26/23 USNM). 32 km SW Calabozo, 69-02-11, P. P.J. Spangler (3/1 USNM). Barinas: 10 km NE Barinas, 69-02-23, P. & P.J. Spangler (0/1 USNM).

77. *Hydraena insularis* d'Orchymont

Map: Figure 172A

Specimens examined: 1

Dominica: 2 mi. NW Pont Casse, 64-10-05, P.J. Spangler (1/0 USNM).

78. *Hydraena marginicollis* Kiesenwetter

Map: Figure 56A

Specimens examined: 177

United States: Alabama: Houston Co.: Chattachoochee Park, creek, 54-06-06, S.N. Brown, F.N. Young (0/1 DPW). Macon Co.: 0.5 mi. E. of Line Cr. on interstate hwy. 85, 67-11-11, G.W. Folkerts (1/0 GWF). Mobile Co.: Mobile, no date, no collr. (2/2 MCZ). Mobile, no date, H.P. Loding (0/1 MCZ). Arkansas: Randolph Co.: 1 mi. N. Maynard, at light in Oak-Maple-Walnut-Juniper woods, 67-08-05, H.B. Leech (0/1 CAS). Florida: Alachua Co.: Payne's Prairie, nr. Gainesville, emergent vegetation at lake shore, 73-08-23, P.D. Perkins (3/3 PDP). 2 mi. N. Santa Fe, small pools adjacent to reservoir, 73-05-21, P.D. Perkins (2/5 PDP). Gainesville, Green Sink, 39-09-25, F.N. Young (0/2 BMNH). Gainesville, Greek Sink, 37-03-08, F.N. Young (1/2 FNY). No site, no date, no collr. (4/1 CU). Charlotte Co.: Punta Gorda, 11-11-16, no collr. (0/1 AMNH). Dade Co.: Miami Springs, at light, 62-08-02, B. Benesh (1/0 CAS). Homestead, 51-06-11, Bryant (1/2 CAS). Duval Co.: Jacksonville, no date, no collr. (0/2 CU). Gadsden Co.: Nr. Mt. Pleasant, Glen Julia Springs, 54-06-06, F.N. Young (1/0 DPW). Hendry Co.: 6 mi. S. LaBelle, litter under water hyacinth at creek, 74-02-04, W.R. Suter (0/1 USNM). LaBelle, 18-02-26, W.S. Blatchley (0/1 AMNH; 3/0 PU). Highlands Co.: Archbold Bio. Station, at black light, 73-12-28, W.R. Suter (2/7 USNM). Venus, Fish Eating Creek, 75-01-20, W.R. Suter (6/16 WRS). Sebring, 39-03-07, no collr. (0/1 AMNH). Sebring, 42-10-10, C. Parsons (0/1 CAS). Hillsborough Co.: Tampa, no date, Hubbard & Schwarz (0/1 USNM). Tampa, no date, F.C. Bowditch (0/1 MCZ). Okeechobee Co.: Okeechobee, 43-03-12, W. Proctor 91/0 CU). Okeechobee, 39-03-13, F.E. Lutz (5/0 AMNH). Palm Beach Co.: Royal Palm Park, 32-04-01, W.S. Blatchley (1/0 PU). L. Worth, no date, no collr. (0/1 AMNH). Pinellas Co.: Dunedin, 30-05-04, W.W. Blatchley (6/6 BMNH). Dunedin, 13-03-15, W.S. Blatchley (0/3

NYSS). Dunedin, no date, no collr. (1/0 CAS). Dunedin, 29-02-21, W.S. Blatchley (3/4 CU). Dunedin, 13-01-22, W.S. Blatchley (1/0 PU). As above, 17-12-23 (1/0 PU). As above, 16-12-21 (0-1 PU). As above, 14-01-03 (0/1 PU). As above, 24-02-03 (0/1 PU). Haven, 22-03-23, W.S. Blatchley (0/1 PU). Dunedin, 18-03-17, W.S. Blatchley (2/1 UW). Putnam Co.: Cresent City, no date, Hubbard & Schwarz (2/3 USNM). Taylor Co.: No site, no date, no collr. (1/2 CU). Volusia Co.: Enterprise, no date, F.C. Bowditch (0/4 MCZ). Enterprise, debris, lake shore, no date, no collr. (0/1 CAS). L. Harney, no date, no collr. (1/0 CU). Unspecified Co.: No site, no date, no collr. (1/0 MCZ; 2/3 CU). Georgia: Lowndes Co.: Valdosta, no date, no collr. (1/0 CU). Louisiana: East Baton Rouge Co.: Baton Rouge, 61-04-29, B. Monroe (0/1 LSU). Madison Co.: Tallulah, 29-09-05, P.A. Glick (0/1 USNM). Tallulah, 33-11-13, Folsom (0/3 MCZ). New Jersey: Unspecified Co.: No site, no date, Wintersteiner (0/1 CU). North Carolina: Currituck Co.: Knotts Island, 72-09-16, P.D. Perkins (10/10 PDP). South Carolina: Florence Co.: Florence, 54-07-22, V.M. Kirk (2/0 VMK).

80. *Hydraena pulsatrix* new species

Map: Figure 56A

Paratypes: 32

Mexico: Tamaulipas: Ciudad Mante, 64-08-22, P.J. Spangler (1/1 USNM). Veracruz: 15 mi. SE Tantcyuca, 65-08-28, P.J. Spangler (1/0 USNM).

United States: Oklahoma, Marshall Co.: Willis, 1 mi. SE, floor, willow swamp, 68-07-06, W. Suter (1/0 USNM). Texas: Cameron Co.: Brownsville, 33-06-11, Darlington (8/11 MCZ). Kinney Co.: Brackettsville, 72-03-21, H.P. Brown (2/1 USNM). San Patricio Co.: 7.5 mi. N. Sinton, Welder Wildlife Foundation, mucky dead grass mat, margin of small lake, 74-01-18, J.L. Bengston (2/0 USNM). Uvalde Co.: Garner St. Pk., Con Can Rio Frio area, Berlese, streamside litter under cypress, 72-07-06, W. Suter (2/0 CFMNH). Val Verde Co.: Devil's River, at light, 07-05-06, Bishopp & Pratt (1/0 USNM). Unspecified Co.: No site, 72-11-22, J.L. Carr (0/1 JLC).

81. *Hydraena longicollis* Sharp

Map: Figure 56A

Specimens examined: 15

Guatemala: Estancia Virgen, 65-08-12, P.J. Spangler (3/2 USNM). Same data as Lectotype (2/2 BMNH) (labelled paralectotypes). Duenas, no date, no collr. (0/1 BMNH) (labelled paralectotype). Paso Antonio, 400', no date, no collr. (0/1 BMNH) (labelled paralectotype).

Mexico: Chiapas: Jct. Rts. 190-195, 69-06-11, J.M. Campbell (1/2 CNC).

Nicaragua: Chontales, no date, no collr. (0/1 BMNH) (labelled paralectotype).

83. *Hydraena anisonycha* new species

Map: Figure 50B

Paratypes: 1,714

Colombia: Cundinamarco: 11 km N. Bogota, 69-01-(1-8), P. & P.J. Spangler (571/826 USNM). 5 km N. Bogota, 69-03-01, P. & P.J. Spangler (122/128 USNM). 12 km S. Tocancipa, 69-03-02, P. & P.J. Spangler (26/11 USNM). Meta: 10 km S. Villavicencio, 69-03-03, P. & P.J. Spangler (14/16 USNM).

84. *Hydraena colymba* new species

Map: Figure 59

Paratypes: 55

Costa Rica: 8 mi. SE Liberia, 65-07-24, P.J. Spangler (2/2 USNM).

Guatemala: Jalapa: Same data as Holotype (15/20 PDP). Jutiapa: Jutiapa, 66-10-29, H.P. Brown (1/0 USNM).

Honduras: Copan, in algae, rain pond, 55-09-08, B. Malkin (1/1 CAS). San Marcos Colon, 65-07-28, P.J. Spangler (1/5 USNM).

Mexico: Chiapas: Jct. Rts. 190-195, 69-06-11, J.M. Campbell (3/1 CNC). As above, 69-06-06 (3/0 CNC).

85. *Hydraena nevermanni* new species

Map: Figure 173

Paratypes: 57

Costa Rica: Same data as Holotype (3/3 USNM). Hamburgfarm, Reventazon ebene Limon stehendem Wasser, 29-10-26, F. Nevermann (1/1 USNM). Reventazon, Hambergfarm, 33-01-28, Ferdinand Nevermann (21/28 CFMNH).

87. *Hydraena pontequula* new species

Map: Figure 173

Paratypes: 165

Panama: Canal Zone: Same data as Holotype (20 RTA; 20 PDP; 10 DCM; 10 USNM). As above, black light, 68-05-24 (5 RTA; 5 DCM; 5 USNM; 5 PDP). Rio Frijoles, 4.1 mi. NW Gamboa, berlese, wet leaves and flood debris along river, 76-02-19, A. Newton (4/0 PDP). Panama: Madden L. near dam, berlese, damp pockets of leaves and debris in streambed, 59-02-15, H.S. Dybas (44/36 CFMNH). As above, 59-02-06 (0/1 CFMNH).

88. *Hydraena sabella* new species

Map: Figure 59

Paratypes: 140

Guatemala: Izabal: 1 mi. N. Morales, 65-08-16, P.J. Spangler (7/48 USNM).

Mexico: Chiapas: 8 mi. W. Teapa, large tropical stream, 74-05-26, M.E. & P.D. Perkins (2/83 PDP).

3. *Spanglerina brevis* (Sharp)

Map: Figure 68B

Specimens examined: 232

Guatemala: Alta verapaz: 20 mi. W. La Tinta, rapid tropical stream, 74-06-07, M.E. & P.D. Perkins (1/32 PDP). 5 mi. W. La Tinta, small tropical brook, 74-06-06, M.E. & P.D. Perkins (0/86 PDP). Baja verapaz: 1 mi. S. San Jeronimo, rapid stream in pines, 74-06-03, M.E. & P.D. Perkins (0/2 PDP). 4 mi. S. Rabinal, stream, transition xeric-tropical, 74-06-10, M.E. & P.D. Perkins (0/7 PDP). Huehuetenango: 21 mi. NW Huehuetenango, 74-06-29, M.E. & P.D. Perkins (0/6 PDP). 7 mi. S. La Mesilla, slightly silty stream, 74-05-30, M.E. & P.D. Perkins (0/1 PDP). 35 mi. S. La Mesilla, tropical brook, 74-05-30, M.E. & P.D. Perkins (0/3 PDP). 26 mi. S. Rabinal, large stream with boulders, 74-06-12, M.E. & P.D. Perkins (0/1 PDP). Jalapa: 10 mi. E. Guatamala City, 65-08-08, P.J. Spangler (0/1 USNM). Suchitepequez: 5 mi. N. Patulul, stream in bananna trees, 74-06-26, M.E. & P.D. Perkins (0/1 PDP).

Honduras: Morazan: 9 mi. N. Sabana Grande, rapid stream, 74-06-22, M.E. & P.D. Perkins (0/1 PDP). Ocotepeque: 14 mi. N. Nueva Ocotepeque, rapid brook in dense vegetation, 74-06-18, M.E. & P.D. Perkins (0/30 PDP).

Mexico: Chiapas: 10 mi. S. Malpaso, 69-05-24, J.M. Campbell (2/1 CNC). nr. Ixtala, Rio Escopetazo, 66-12-03, H.P. Brown (0/3 HPB). 9 mi. N. Tapilula, tropical stream, 74-05-27, M.E. & P.D. Perkins (0/2 PDP). 4 mi. N. Bochil, stream in pine forest, 74-05-28, M.E. & P.D. Perkins (0/2 PDP). Colima: El Cobano, 70-03-25, H.P. Brown (0/1 PDP). Guerrero: El Limon, 69-04-04, H.P. Brown (0/1 PDP). Oaxaca: 1 mi. N. Ixtlan de Juarez, stream in oak-pine, 74-07-03, M.E. & P.D. Perkins (0/1 PDP). 4 mi. S. Valle National, cascading tropical brook, 74-07-06 (2/20 PDP). 8 mi. E. Tapanatepec, tropical stream with large boulders, 74-07-03, M.E. & P.D. Perskins (0/25 PDP).

Panama: Chiriqui: Bambito, small trib. of Rio Chiriqui, 66-11-17, H.P. Brown (0/1 PDP).

1. *Limnebius discolor* Casey

Map: Figure 78B

Specimens examined: 216

United States: Indiana: Brown Co.: Caldwell's Hollow near Belmont, 64-10-01, H. Clifford (3/5 FNY). Maryland: Frederick Co.: Thurmont, C.F. St. Pk., 76-09-18, P.J. Spangler (7/3 USNM). Missouri: Reynolds Co.: Ellington, Logan Cr., 56-08-19, P.J. Spangler (2/0 USNM). Pennsylvania: Potter Co.: Ole Bull St. Park, 66-08-20, P.J. Spangler (4/5 USNM). Virginia: Bath Co.: 12 mi. S. Williamsville, pebbly stream, 73-10-06, P.D. Perkins (92/95 PDP).

3. *Limnebius ozapalachicus* new species

Map: Figure 78B

Paratypes: 300

United States: Kentucky: Ohio Co.: Fordsville, 72-08-12, P.D. Perkins (9/8 PDP). Maine: Penobscot Co.: Corinth, 69-07-22, S. Malcolm (1/0 DCM). Missouri: Cape Girardeau Co.: Cape Girardeau, La Croix Cr., 56-09-13, P.J. Spangler (2/7 USNM). Same, 53-09-11 (19/20 USNM). Cape Girardeau, 54-05-10, D. Stout (1/0 USNM). 5 mi. S. Columbia, 54-04-19, P.J. Spangler (2/3 USNM). Crawford Co.: Merrimac River, 54-11-21, P.J. Spangler (5/10 USNM). Same, 53-07-21 (3/3 USNM). Dallas Co.: Bennett Springs, 56-07-07, P.J. Spangler (2/2 USNM). Dent Co.: 5 mi. E. Salem, 55-10-10, P.J. Spangler (1/4 USNM). Greene Co.: 3 mi. E. Springfield, Sac River, 56-04-13, P.J. Spangler (7/19 USNM). Madison Co.: Mine La Motte, 53-09-09, P.J. Spangler (6/0 USNM). Maries Co.: Vienna, 56-09-25, P.J. Spangler (15/31 USNM). McDonald Co.: Rush Cr., 2 mi. E. Jane, 72-08-08, P.D. Perkins (9/21 PDP). 10 mi. E. Anderson, 60-07-12, E. Todd (0/2 USNM). Reynolds Co.: Bunker, Sugar Creek, 56-08-08, P.J. Spangler (1/0 USNM). Ellington, Logan Creek, 56-08-08, P.J. Spangler (3/0 USNM). Ripley Co.: Doniphan, Logan Creek, 56-04-23, P.J. Spangler (2/0 USNM). Oklahoma: Wagoner Co.: 14 mi. E. Wagoner, 64-06-20, P.J. Spangler (28/17 USNM). Tennessee: Humphreys Co.: Near Buffalo, 62-07-20, F.N. Young (5/9 FNY). Virginia: Bath Co.: 12 mi. S. Williamsville, pebbly stream, 73-10-06, P.D. Perkins (11/10 PDP). West Virginia: Hardy Co.: 6 mi. SW Wardensville, 74-10-12, P.D. Perkins (2/0 PDP).

4. *Limnebius piceus* (Horn)

Map: Figure 76D

Specimens examined: 257

Mexico: Baja California: Baja California Norte, Arr. Santo Domingo, 5.7 mi. E. Hamilton Ranch, dam site, 63-04-23, P.H. Arnaud, Jr. (13/12 CAS). La Suerte, Sierra San Pedro Martir, pool in canyon, 3700', 63-06-04, R.K. Benjamin (1/2 CAS).

United States: California: Calaveras Co.: Waterman Cr., 4.5 mi. W. of Altaville, Hwy, 4, 63-08-31, H.B. Leech (2/1 CAS). Colusa Co.: Little Stony Cr., 6 mi. S. Stonyford, 56-03-29, H.B. Leech (1/1 CAS). Contra Costa Co.: Mt. Diablo, 19-09-21, no collr., (1/0 CAS). Fresno Co.: Kings River Camp, 50-08-23, P.S. Bartholomew (8/11 CAS). Glenn Co.: Trib. to Stony Cr., 7 mi. N. Stonyford, 56-03-29, H.B. Leech (1/1 CAS). Lake Co.: North Fork Cache Cr. at Route 20, 312 m., 71-10-10, H.B. Leech (1/3 CAS). Los Angeles Co.: Pasadena, no date, H.C. Fall (1/0 CAS). Big Rock Creek, San Gabriel Mts., 59-03-31, P.H. Raven (4/0 CAS). Los Angeles, no date, no collr. (2/3 USNM). Monterey Co.: Carmel River, 50-08-20, P.S. Bartholomew (15/22 CAS). Carmel, 56-09-21, B. Malkin (1/0 CFMNH). Same, 53-06-28 (8/7 CFMNH). Napa Co.: Soda Cr. at Highway 128, 64-08-30, H.B. Leech (1/0 CAS). Pope Cr. at Walter Springs Rd., 520', 64-08-31, H.B. Leech (4/9 CAS). Same, 71-07-17, P.D. Perkins (9/20 PDP). Placer Co.: Squaw Valley Cr., 55-06-25, P.S. Bartholomew (1/1 CAS). Riverside Co.: Palm Canyon, 16-04-15, J.O. Martin (1/0 CAS). Palm Springs, no date, Hubbard & Schwarz (1/1 USNM). San Jacinto Mts., no date, F.E. Winters (1/1 CAS). Riverside, no date, F.E. Winters (1/1 MCZ). San Bernardino Co.: Mojave River near Victorville, 56-02-12, R.K. Benjamin (5/3 CAS). Hesperia, 18-06-30, no collr. (4/5 CAS). San Diego Co.: Camp Pendleton, Oceanside, 45-10-26, H.P. Chandler (19/23 CAS). Santa Barbara Co.: Santa Barbara, no date, F.E. Winters, (5/9 CAS). Cuyama River, ca 10 mi. E. Santa Maria, 52-07-21, H.B. Leech (2/3 CAS). Stanislaus Co.: Adobe Cr., 16 mi. W. of Patterson, 48-04-25, H.B. Leech (2/2 CAS). Tulare Co.: Kaweah, no date, no collr. (1/0 CAS).

5. *Limnebius alutaceus* (Casey)

Map: Figure 76A

Specimens examined: 434

Canada: British Columbia: Copper Mtn., 30-10-12, G. Stace Smith (2/1 CAS; 9/9 UBC). Enderby, Shuswap River, 46-10-11, H.B. Leech (6/5 CAS; 0/2 UBC). Salmon Arm, Salmon River, 46-10-13, H.B. Leech (1/0 CAS). Lister, pond, 2000 feet, 37-08-12, G. Stace Smith (1/0 UBC). Creston, Goat River, 46-09-01, G. Stace Smith (1/0 MCZ). Cariboo Dist., Beedy Cr. at Gaston Rch., 30 mi. NE McLeese Lake, 71-07-25, P.D. Perkins (10/12 PDP). Cariboo Dist., Beaver Cr., 40 mi. NE McLeese Lake, 71-07-28, P.D. Perkins (23/34 PDP).

United States: California: Colusa Co.: Indian Cr., 1.5 mi. along road to Cooks Springs, SW of Lodoga, 71-10-10, H.B. Leech (1/0 CAS). El Dorado Co.: Rubicon River at Georgetown-Ralston Rd., 63-07-27, H.B. Leech (1/0 CAS). Glenn Co.: Trib. to Stony Cr., 7 mi. N. Stonyford, 56-03-29, H.B. Leech (1/5 CAS). Humboldt Co.: Hydesville, no date, no collr., (1/0 CAS). Korbel, 16-06-16, F.E. Blaisdell (6/2 CAS). Bear River at Capetown, 65-10-01, H.B. Leech (2/1 CAS). N. Fork Mattole River, NW of Petrolia, 65-10-02, H.B. Leech (1/2 CAS). Toss-up Cr., confluence with Redwood Cr., 2.5 mi. N. of road to Hoopa, ca 650 ft., 70-08-13, H.B. Leech (2/1 CAS). Lake Co.: Creek behind Cottage City Resort, Lucerne, 53-07-05, H.B. Leech (6/8 CAS). Bartlett Cr., Bartlett Springs, 55-08-01, H.B. Leech (4/4 CAS). Middle Cr., 5 mi. N. of Upper Lake, 55-08-04, H.B. Leech (3/13 CAS). Headwaters, Long Valley Cr., 3750 ft., 55-08-01, H.B. Leech (2/1 CAS). Los Angeles Co.: Pasadena, no date, Winters (1/0 CAS). Big Rock Cr., San Gabriel Mts., 59-03-31, P.H. Raven (1/0 CAS). San Fernando, no date, no collr. (1/0 MCZ). Madera Co.: Jackass Cr.,

E. end Jackass Meadow, 6960 ft., 71-08-17, H.B. Leech (3/4 CAS). Mendocino Co.: Rancheria Cr., 2 mi. S. Yorkville, tiny stream, 54-07-25, H.B. Leech (1/1 CAS). Rancheria Cr., 5.5 mi. SE Boonville, 50-06-15, H.B. Leech (1/2 CAS). Middle Fork of Eel River, 0.3 mi. below mouth of Black Butte River, 1500', 68-07-16, H.B. Leech (2/0 CAS). Eel River, 4.5 mi. NW of Lanes Redwood Flat, 60-08-05, H.B. Leech (7/6 CAS). Navarro River, 2 mi. NW Philo, Hendy Woods State Park, 64-07-22, P. Rubtzoff (2/1 CAS). Garcia River at Highway 1, 64-10-12, H.B. Leech (1/4 CAS). Navarro River, 8 mi. W. Navarro, 50-06-15, H.B. Leech (3/0 CAS). Beebe Cr., 50-09-05, H.B. Leech (1/0 CAS). Williams Cr. at Covelo-Paskenta Rd., 70-10-17, H.B. Leech (1/1 CAS). Outlet Cr., 1 mi. ENE of Longvale Dos Rios Rd., 70-08-07, H.B. Leech (1/1 CAS). Napa Co.: Pope Cr. at Walter Springs Rd., 520', 640-08-31, H.B. Leech (4/0 CAS). 6 mi. NE Rutherford, 71-07-16, P. D. Perkins (1/0 PDP). Plumas Co.: Clio, on Middle Fork Feather River, 61-08-28, H.B. Leech (5/8 CAS). Chester, 14-10-15, R. Hopping (1/2 CAS). San Bernardino Co.: Lake Arrowhead, 44-07-24, G.P. Mackenzie (1/0 CAS). Santa Barbara Co.: Santa Barbara, no date, F.E. Winters (1/5 CAS). Santa Clara Co.: Gilroy Hot Springs, 15-07-07, no collr. (1/0 CAS). San Martin, 52-06-26, P.S. Bartholomew (1/0 CAS). Sierra Co.: Onion Cr., N. end Onion Valley, 60751, 64-10-21, H.B. Leech (1/0 CAS). Siskiyou Co.: Sugar Cr., 2.3 mi. NW of Callahan, 66-08-17, H.B. Leech (1/0 CAS). Etna Cr., 1.5 mi. SW of Etna, 3100', 70-08-20, H.B. Leech (1/3 CAS). No site, no date, A. Koebele (2/2 USNM). Sonoma Co.; Austin Cr., 2 mi. S. Cazadero, 54-10-30, H.B. Leech (5/1 CAS). Austin Cr., 2.5 mi. up from its mouth, 64-09-28, H.B. Leech (1/0 CAS). Wheatfield Br. of Gualala River at bridge, Annapolis & Stewarts Point-Healdsburg Rd., 64-09-07, H.B. Leech (1/1 CAS). Russian R., bank, 2 mi. below Guerneville town, 64-09-28, H.B. Leech (4/2 CAS). Guerneville, 08-07-23, F.E. Blaisdell (1/0 CAS). Cloverdale, 26-06-19, V.S. Brown (1/0 CAS). Santa Rosa, 94-10-10, no collr. (1/0 UW). The Geysers, 70-09-07, P.D. Perkins (3/3 PDP). Trinity Co.: Mad River, 6 mi. S. Ruth, 60-07-31, H.B. Leech (4/8 CAS). Salt Creek at Peanut, 60-08-01, H.B. Leech (2/2 CAS). Mad River just above mouth Van Horn Cr., 4.25 air miles SE of Ruth, 70-08-07, H.B. Leech (1/0 CAS). Tuolumne Co.: Jackass Cr., 4.2 mi. SE of Priest, on Coulterville Rd., 2100', 62-08-19, H.B. Leech (1/0 CAS). Niagara Cr., Forest. Campgd., 62-08-09, H.B. Leech (2/0 CAS). Pinecrest, 48-07-13, P.H. Arnaud (1/1 CAS). Blaine Co.: Wood River, 69-09-10, Schuh, Phipps & Coulson (1/1 JS). Idaho: Lemhi Co.: Salmon R., 4 mi. N. Salmon, 71-08-03, P.D. Perkins (1/0 PDP). Montana: Ravalli Co.: Mill Cr. at Hwy. 93, 7 mi. N. Hamilton, 71-08-02, P.D. Perkins (32/55 PDP). Oregon: Curry Co.: Euchre Cr. at Hwy. 101 by Ophir, 65-09-28, H.B. Leech (7/8 CAS). Pistol River, 52-06-18, B. Malkin (4/3 CFMNH). Douglas Co.; S. Umpqua R. at Canyonville, 71-07-17, P.D. Perkins (4/3 PDP). Washington: King Co. Green River Gorge, 56-07-15, Malkin & Kottke (2/1 CFMNH).

6. *Limnebius arenicolus* new species

Map: Figure 76C

Paratypes: 472

Mexico: Baja California: Sierra San Pedro Martir, La Grulla, 6900', 52-06-12, P.H. Arnaud, Jr. (1/1 CAS).

United States: California: Butte Co.: Little Chico Cr. at School Rd., E. of Forest Ranch, 2300', 61-09-01, H.B. Leech (2/0 CAS). Glenn Co.: NW corner Glenn Co., Plaskett Mdws., 6000', stream from N. entering Lower Plaskett Lake, 60-07-28, H.B. Leech (15/9 CAS). NW corner Glenn Co., 4.5 mi. NW of Lanes, Redwood Flat, 60-08-05, H.B. Leech (1/0 CAS). Humboldt Co.: Korbel, 16-06-16, no collr. (2/4 CAS). Willow Creek, 16-06-12, F.E. Blaisdell (2/2 CAS). Green Point Ranch, 1500', 16-06-05, F.E. Blaisdell (1/1 CAS). N. Fork Yager Cr. at Bridgeville-Kneeland Road, 66-08-08, H.B. Leech (1/3 CAS). Toss-up Creek, confluence with Redwood Creek, 2.5 mi. N. of road to Hoopa, 650', 70-08-13, H.B. Leech (1/0 CAS). Lake Co.: Creek behind Cottage City Resort, Lucerne, 53-07-05, H.B. Leech (1/0 CAS). Bartlett Creek, Bartlett Springs, 55-08-01, H.B. Leech (1/0 CAS). Headwaters, Long Valley Cr., 3750', 55-08-01, H.B. Leech (2/1 CAS). Little Blue Lake, 47-11-08, H.P. Chandler (1/0 CAS). Los Angeles Co.: Pasadena, no date, H.C. Fall (2/0 CAS). Pasadena, no date, no collr. (2/2 CAS). Pasadena, no date, A. Fenyes (1/1 CAS; 1/1 CFMNH; 1/2 CU; 1/0 MCZ). Pasadena, 17-09-06, J.O. Martin (6/2 CAS). Pomona, no date, no collr. (1/1 USNM). Big Rock Cr., San Gabriel Mts., 59-03-31, P.H. Raven (3/8 CAS). Marin Co.: Lake Lagunitas, 19-10-18, J.O. Martin (21/20 CAS). Same, 19-01-09 (1/2 CAS). Mill Valley, Cascade Creek, 51-05-09, R.E. Leech (4/14 CAS). Same, 52-04-04 (8/8 CAS). Mill Valley, Cascade Cyn., roadside trickle, 57-03-31, H.B. Leech (1/1 CAS). Mill Valley, 57-04-25, H.B. Leech (1/0 CAS). Muir Woods, 08-08-30, no collr. (1/1 CAS). Muir Woods, 47-10-13, D. Giuliani (1/0 CAS). Lagunitas, no date, F.E. Blaisdell, (5/2 CAS). Lagunitas Cr. at Tocaloma, 68-05-04, H.B. Leech (3/4 CAS). Redwood Cr. at Hwy. 1, 71-10-24, P.D. Perkins (5/5 PDP). No site, 19-10-18, J.O. Martin (1/1 CAS). Mendocino Co.: Bloody Run Cr., 7 mi. E. of Route 101 on Longvale-Covelo road, 1100', 68-07-18, H.B. Leech (5/3 CAS). Dry Cr., Hwy. 128, 64-09-05, W.B. Leech (1/0 CAS). Pardaloe Cr., 1 mi. SW Mailliard Redwoods State Park, 64-09-06, H.B. Leech (2/0 CAS). Eel River, 4.5 mi. NW of Lanes, Redwood Flat, 60-08-05, H.B. Leech (1/0 CAS). McDowell Cr., at foot of grade below Oasis, 1000', 55-07-27, H.B. Leech (12/2 CAS). Rancheria Cr., 5.5 mi. SE Booneville, 50-06-15, H.B. Leech (1/0 CAS). Longvale Cr., 38-07-27, no collr. (1/1 CAS). Beebe Cr., 50-09-05, H.B. Leech (2/3 CAS). Bear Pen Canyon Cr. just above junction with Burger Cr., Dos Rios-Laytonville Rd., 72-08-30, H.B. Leech (1/0 CAS). Baechtel Creek, 3 mi. W. Willits, 48-06-15, H.B. Leech (4/2 CAS). Monterey Co.: Tassajara Hot Springs, 54-05-26, Bryant, (14/8 CAS). Carmel, 31-07-18, no collr. (1/1 CAS). Nacimiento River, Ponderosa Public Camp, 70-09-06, P.D. Perkins (20/30 PDP). Carmel, 53-06-28, B. Malkin (1/0 CFMNH). Napa Co.: Campbell Cr.,

51-04-10, H.B. Leech (3/0 CAS). Pope Cr. at Walter Springs Rd., 520', 64-08-18, H.B. Leech (1/0 CAS). 6 mi. NE Rutherford, 71-07-16, P.D. Perkins (2/1 PDP). Nevada Co.: Sagehen Cr., 6300', 66-07-20, W.J. Turner (8/3 UBC). Same, 67-07-18 (4/7 UBC). Plumas Co.: Chester, 14-10-15, R. Hopping (1/0 CAS). Riverside Co.: San Jacinto Mts., 4000', no date, F.E. Winters (3/2 CAS). San Bernardino Co.: Hesperia, 18-06-30, no collr. (2/1 CAS). San Diego Co.: Camp Pendleton, Oceanside, 45-10-15, H.P. Chandler (1/0 CAS). San Mateo Co.: La Honda, 25-07-29, F.E. Blaisdell (2/0 CAS). No site, no date, no collr. (4/4 CAS). Santa Barbara Co.: Santa Barbara, no date, F.E. Winters (1/0 CAS; 1/2 CU). Santa Inez Mts., no date, F.E. Winners (1/1 CAS). Santa Barbara Mts., no date, H.C. Fall (1/0 MCZ). Santa Clara Co.: Los Gatos, 04-06-10, no collr. (1/0 CAS). Santa Cruz Co.: Ben Lomond, 60-10-10, D. Miller (1/0 CAS). Shasta Co.: Bailey Cr., 2.5 mi. W. & S. of Viola, 61-08-31, H.B. Leech (4/0 CAS). Cottonwood Cr., N.F., 52-10-24, H. P. Chandler (1/0 CAS). Sonoma Co.: Austin Cr., 2 mi. S. Cazadero, 54-10-30, H.B. Leech (1/0 CAS). Mark West Cr. at Calistoga Rd., ca 4 mi. S. of Petrified Forest, 63-07-08, H.B. Leech (1/1 CAS). Guerneville, 08-07-23, F.E. Blaisdell (4/2 CAS). Duncan Mills, 08-06-28, F.E. Blaisdell (1/3 CAS). Sonoma Creek, Glen Ellen, 50-04-29, H.B. Leech (1/0 CAS). Calistoga, 34-06-12, Bryant (2/4 CAS). Camp Meeker, no date, Wintersteiner (3/2 CAS). Camp Meeker, 51-07-10, P.S. Bartholomew (1/2 CAS). Duncan Mills, 08-07-04, no collr. (4/1 USNM). No site, no date, no collr. (2/0 CAS). No site, no date, Hubbard & Schwarz (3/6 USNM). Trinity Co.: SW corner Trinity Co., Wilson Cr., Lake Mtn. area, 60-07-30, H.B. Leech (3/11 CAS). Big Slide Cr., 5 mi. NW of Hyampon, 68-07-24, H.B. Leech (2/0 CAS). Little Brown Cr. at Route 3, ca 3 mi. airline SW Douglas City, 70-08-11, H.B. Leech (2/1 CAS). Bridge Gulch Cr. at Natural Bridge, 7.5 mi. airline N. Wildwood, 70-08-10, H.B. Leech, (1/0 CAS). Mad River just above mouth Van Horn Cr., 4.25 air miles SE of Ruth, pools in drying bed of upper Mad River, 70-08-07, H.B. Leech (1/1 CAS). Hayfork Creek at Hayfork-Wildwood Rd., 70-08-11, H.B. Leech (1/1 CAS). Van Horn Creek, 1.5 mi. above its mouth at upper Mad River, 2850', 70-08-09, H.B. Leech (5/3 CAS). Tuolumne Co.: Jackass Cr., 4.2 mi. SE of Priest, on Coulterville Rd., 2100', 62-08-19, H.B. Leech (5/3 CAS). Niagara Cr., Forest Campgd., 6600', 62-08-09, H.B. Leech (1/1 CAS). Oregon: Curry Co.: Myers Cr., Pistol River, 38-05-18, H.B. Leech (2/1 CAS). Klamath Co.: 11 mi. NE Bly, edge Deming Cr., 66-05-13, J. Schuh (1/0 JS). Lake Co.: Warner Cr., Warner Cyn., N. of Lakeview, 56-07-01, H. B. Leech (1/0 CAS). Lakeview, 52-06-22, B. Malkin (2/1 CFMNH). Washington Co.: Banks, 58-08-09, P.S. Bartholomew (4/5 CAS).

7. *Limnebius leechi* new species

Map: Figure 76B

Paratypes: 54

United States: California: Lake Co.: Creek behind Cottage City Resort, Lucerne, 53-07-05, H.B. Leech (3/1 CAS). Kelseyville, Kelsey Creek, 49-05-29, H.B. Leech (4/0 CAS). Headwaters, Long Valley Cr., 3750', 55-08-01, H.B. Leech (2/4 CAS). Los Angeles Co.: Mt. near Claremont, no date, Baker (1/1 CMP). Madera Co.: Windy Gap, 2000', 46-07-13, H.P. Chandler (1/2 CAS). Mendocino Co.: McDowell Cr., just below Oasis, 1800', 55-07-27, H.B. Leech (4/4 CAS). Monterey Co.: The Indians, 2 mi. SE of Santa Lucia Memorial Park, seepage trickle over gravelly soil, 56-01-15, H.B. Leech (1/0 CAS). Napa Co.: 6 mi. NE Rutherford, 71-07-16, P.D. Perkins (2/6 PDP). San Bernardino Co.: Lake Arrowhead, 44-07-27, G.P. Mackenzie (1/2 CAS). Hesperia, 18-06-30, no collr. (1/0 CAS). Lake Arrowhead, 53-07,26, G.H. Nelson (2/0 MCZ). San Diego Co.: San Vicente, 59-02-25, I. Moore (1/0 CAS). Camp Pendleton, Oceanside, 45-10-26, H.P. Chandler (1/0 CAS). Santa Clara Co.: San Antonio Vall., 48-03-11, J.W. MacSwain, (1/0 UCB). Trinity Co.: SW corner Trinity Co., Wilson Cr., Lake Mtn. area, 60-07-30, H.B. Leech (2/0 CAS). Mad River just above mouth Van Horn Creek, 4.25 air miles SE of Ruth, pools in drying bed of Upper Mad River, 70-08-07, H.B. Leech (4/2 CAS).

8. *Limnebius borealis* new species

Map: Figure 76B

Paratypes: 37

Canada: British Columbia: Enderby, Shuswap River, 46-10-11, H.B. Leech (7/5 CAS).

United States: Montana: Blaine Co.: Bear Paw Mt., no date, Hubbard & Schwarz (8/8 USNM). Ravalli Co.: Mill Cr. at Hwy. 93, 7 mi. N. Hamilton, 71-08-02, P.D. Perkins (9/0 PDP).

10. *Limnebius sinuatus* (Sharp)

Map: Figure 74

Specimens examined: 623

Guatemala: Baja Verapaz: 34 mi. S. Rabinal, stream in semi-arid hills, 74-06-12, ME & PD Perkins (3/4 PDP). 1 mi. S. San Jeronimo, rapid stream in pines, 74-06-03, ME & PD Perkins (2/1 PDP). Huehuetenango: 35 mi. S. La

Mesilla, tropical brook, 74-05-31, ME & PD Perkins (5/9 PDP). 6 mi. NW Huehuetenango, stream in oak-pine, 74-06-29, ME & PD Perkins (45/60 PDP). 42 mi. S. La Mesilla, outwash area of river, 74-05-31, ME & PD Perkins (25/29 PDP). 2 mi. NW Huehuetenango, stream in oak-pine, 74-06-29, ME & PD Perkins (13/16 PDP). Jalapa: 6 mi. N. Jalapa, slow stream in open, xeric situation, 74-06-15, ME & PD Perkins (28/45 PDP). Totonicapan: 25 mi. S. Huehuetenango, small rapid stream, 74-06-01, ME & PD Perkins (1/0 PDP).

Mexico: Chiapas: 4 mi. N. Bochil, stream in pine forest, 74-05-28, ME & PD Perkins (7/6 PDP). Durango: 15 mi. W. Durango, river outwash area, 74-07-17, ME & PD Perkins (11/14 PDP). Jalisco: 20 mi. NE La Huerta, rapid tropical stream, 74-07-22, ME & PD Perkins (3/4 PDP). Oaxaca: 14 mi. N. Huajuapam de Leon, 74-07-09, P.D. Perkins (5/8 PDP). 21 mi. SE Huajuapam de Leon, brook in scrub-thorn desert, 74-07-09, ME & PD Perkins (14/10 PDP). 7 mi. NE Oaxaca, 74-07-08, ME & PD Perkins (1/1 PDP). San Luis Potosi: 2 mi. S. San Luis Potosi, 48-11-21, H.B. Leech (3/0 CAS). 6 mi. W. San Luis Potosi, stream outwash in desert 74-07-26, P.D. Perkins (4/0 PDP). Zacatecas: 13 mi. S. Jalpa, stream in desert, 74-07-16, ME & PD Perkins (1/2 PDP). 29 mi. SW Zacatecas, stream in desert, 74-07-16, ME & PD Perkins (2/4 PDP).

United States: Arizona: Cochise Co.: Sunnyside Cyn., W. side Huachuca Mts., 6000', 52-08-04, H.B. Leech, (3/1 CAS). Chiricahua Mts., 3/5 mi. SW Portal, 5000', 52-08-13, H.B. Leech (2/9 CAS). Huachuca Mts., Garden Canyon, 50-06-02, C.P. Alexander (0/1 MCZ). Portal, SWRS, 76-05-14, W.E. Steiner (4/7 USNM). Chiric, Mts., no date, Hubbard & Schwarz (5/4 USNM). SW Res. Sta., 63-07-11, P.J. Spangler (38/47 USNM). Chiricahua Mts., above Herb Martyr, 74-06-22, H.P. Brown (9/2 HPB). Coconino Co.: Midgley Bridge, Oak Cr. Canyon, 52-08-25, H.B. Leech (11/16 CAS). Gila Co.: Globe, 48-10-13, F.H. Parker (2/10 CAS). Pinal Creek, Globe, 4000', 53-04-24, A. & H. Dietrich (1/0 CU). Pima Co.: Santa Catalina Mts., 34-02-04, Bryant (1/0 CAS). Santa Cruz Co.: Yank's Spring, Sycamore Cyn., Tumacacori Mts., 52-08-03, H.B. Leech (3/7 CAS). Colorado: Routt Co.: Steamboat Springs, 41-10-01, O. Bryant (1/0 CAS). Texas: Jeff Davis Co.: Limpia Creek, 74-06-26, H.P. Brown (5/5 PDP). Limpia Creek Canyon, Davis Mts., 52-09-05, B. Malkin (20/24 CFMNH).

16. *Limnebius octolaevis* new species

Map: Figure 74

Paratypes: 31

Guatemala: Baja Verapaz: 4 mi. S. Rabinal, stream, transition xeric-tropical, 74-06-10, ME & PD Perkins (2/0 PDP). 10 m. S. Rabinal, 74-06-12, ME & PD Perkins (3/0 PDP). Totonicapan: Same data as holotype (14/12 PDP).

4. *Gymnochthebius germaini* (Zaitzev)

Map: Figure 87A

Specimens examined: 60

Argentina: Chubut: Hoyo de Epuyen, 74-02-10, O.S. Flint (1 USNM). Neuquen: 9 km SE San Martin de los Andes, 74-01-24, O.S. Flint (2 USNM).

Chile: Cautin: 8 km E. Temuco, 51-01-08, Ross & Michelbacher (1 CAS). Lanco, 69-06-03, P. & P. Spangler (22 USNM). Concepcion: Cabrero, 69-06-02, P. & P. Spangler (1 USNM). Maule: Rio Nirivilo, 71-11-02, H.P. Brown (1 USNM). Orsorno: 8 km S. Orsorno, 69-06-04, P. & P. Spangler (13 USNM). Valdivia: 8 mi. E. Rio Bueno, 51-01-15, Ross & Michelbacher (2 CAS). San Jose Mariquina, 69-06-07, P. & P. Spangler (13 USNM). 4 km. N. San Jose Mariquina, 69-06-03, P. & P. Spangler (1 USNM). Valparaiso: Colliquay, 63-11-05, L. Pena (1 MCZ).

5. *Gymnochthebius chilenus* (J. Balfour-Browne)

Map: Figure 87A

Specimens examined: 13

Chile: Maule: Rio Nirivilo, 71-11-02, H.P. Brown (10 USNM). Rio Maule, 71-11-02, H.P. Brown (2 USNM). Concepcion: Cabrero, 69-06-02, P. & P. Spangler (1 USNM).

6. *Gymnochthebius clandestinus* new species

Map: Figure 87B

Paratypes: 190

Chile: Cautin: Lanco, 69-06-03, P. & P. Spangler (7 USNM). Pitrufquen, 69-06-03, P. & P. Spangler (3 USNM). Concepcion: Escuadron, 69-05-30, Spangler & Cekalovic (66 USNM). Malleco: 11 km N. Victoria, Rio Dumo, potholes, 78-01-25, P.J. Spangler (20 USNM; 20 MHNC). Maule: Rio Nirivilo, 71-09-02, H.P. Brown (26 USNM).

Orsorno: 8 km S. Orsorno, 69-06-04, P. & P. Spangler (22 USNM). Valdivia: 8 mi. E. Rio Bueno, pond in field, 51-01-15, Ross & Michelbacher (8 CAS). Pichi Ropulli, 69-06-04, P. & P. Spangler (2 USNM). 4 km N. San Jose Mariquina, 69-06-03, P. & P. Spangler (14 USNM). San Jose Mariquina, 69-06-07, P. & P. Spangler (2 USNM).

7. *Gymnochthebius tectus* new species

Map: Figure 87B
Paratypes: 11
Chile: Maule: Rio Nirivilo, 71-11-02, H.P. Brown (1 USNM). Santiago: Farellones, 62-04-08, L. Pena (10 MCZ).

11. *Gymnochthebius topali* (J. Balfour-Browne)

Map: Figure 90B
Specimens examined: 18
Argentina: Rio Negro, El Bolson, 61-10-13, Topal (10 HNHM)
Chile: Bio-Bio: Negrete, 51-01-29, Ross & Michelbacher (4 CAS). Cautin: 20 km E. Temuco, 51-01-07, Ross & Michelbacher (4 CAS).

17. *Gymnochthebius nitidus* (LeConte)

Map: Figure 90A
Specimens examined: 61
Canada: Ontario: Essex Co.: Wheatley, 67-05-01, K. Stephan (6 KS). Kent Co.: Tilbury, 67-06-01, K. Stephan (7 KS). Northwest Territories: Rabbitskin R., 23 mi. SE Ft. Simpson, 72-06-12, A. Smetana (1 CNC). Quebec: Kazubazua, 31-08-18, W.J. Brown (1 CNC). Wakefield, 30-06-04, W.J. Brown (6 CNC). Pettit, no date, Hubbard & Schwarz (1 CNC: 3 USNM).

United States: Fairfield Co.: Cornwall, 20-05-16, Chamberlain (1 MCZ). St. Vincent, no date, no collr. (4 CAS). Illinois: Champaign Co.: Mahomet, Nettie Hart Woodland Memorial, black lite trap, 66-09-03, M.W. Sanderson (1 PDP). Cook Co.: Riverside, 09-04-25, F. Psota (3 CFMNH). Iowa: Johnson Co.: Iowa City, 96-05-03, no collr. (1 USNM). Michigan: Eaton Co.: Grant Ledge, no date, Hubbard & Schwarz (1 USNM). Oakland Co.: No site, 21-07-03, M.H. Hatch (6 UWA). Washtenaw Co.: No site, 21-07-05, M.H. Hatch (1 UWA). Missouri: Boone Co.: Silver Fork St. St. 5, 76-08-18, R.W. Shepard (1 USNM). Jackson Co.: Englewood, Cedar Creek, 54-10-09, P.J. Spangler (1 USNM). Montana: Blaine Co.: Bear Paw Mt., no date, Hubbard & Schwarz (9 USNM). New Jersey: Passaic Co.: Totowa, no date, Wintersteiner (1 CAS). New York: Tompkins Co.: Ithaca, 19-09-05, E.A. Richmond (1 CAS). Pennsylvania: No site, no date, no collr. (1 CNC; 2 ASP; 1 USNM; 1 CAS).

18. *Gymnochthebius fossatus* (LeConte)

Map: Figure 92B
Specimens examined: 722
Argentina: Tucuman: 20 km S. Tucuman, 69-05-23, P. & P. Spangler (18 USNM).
Bolivia: Santa Cruz: Santa Cruz, 69-05-12, P. & P. Spangler (1 USNM). Okinawa, 58-06-06, E. Pinckert (1 CAS).
Brazil: Ceara: Riacho Cobra pres Arara, 37-09-23, O. Shubart (2 ISNB). Goias: Santa Isable, Ilha do Bananal, Rio Araguaia, 57-08-20, B. Malkin (73 CAS). Pernambuco: Belem, Rio Sao Francisco, shoreline of shallow water on a small island, adhering to stones, 37-09-03, O. Shubart (1 ISNB). Bom Jardim, Lagoa de Palma, 37-11-10, O. Shubart (2 ISNB). Rio Grande do Norte: Ceara-Mirim, 69-07-07, P. & P. Spangler (1 USNM).

Colombia: Atlantico: Barranquilla, 69-03-18, P. & P. Spangler (1 USNM). Magdalena: 8 km E. Baranquilla, 69-03-19, P. & P. Spangler (2 USNM).

Cuba: Soledad, (Cienfuegos), 36-04-15, Darlington (28 MCZ). Cauto El Cristo, Cauto R., 36-08-12, Darlington (2 MCZ). No site, no date, no collr. (3 ASP).

Guatemala: Escuintala: 17 mi. E. Escuintla, 65-07-08, P.J. Spangler (5 USNM).
Honduras: Comayagua: Stream near south end Lago de Yojoa, 74-06-19, M.E. & P.D. Perkins (2 PDP). Cortes: 24 mi. S. San Pedro Sula, clear, slow stream, 74-06-19, M.E. & P.D. Perkins (6 PDP). Choluteca: San Marcos Coln, 65-07-28, P.J. Spangler (5 USNM).

Jamaica: Kingston, 34-08-29, Darlington (1 MCZ). St. Catherine, Bushy Park, ex. small pool in narrow gully, 47-02-09, G.B. Thompson (5 IOJ).

Mexico: Aguascalientes: Aguascalientes, 63-08-05, P.J. Spangler (56 USNM). Baja California: Arroyo de la

Purisima, 1 mi. upstream from town, 58-12-27, H.B. Leech (13 CAS). Chiapas: 8 mi. W. Teapa, large tropical stream, 74-05-26, ME & PD Perkins (5 PDP). Distrito Federal: Mexico City, 50-07-30, Drake & Hottes (1 USNM). Durango: Durango, no date, Wickham (1 MCZ). 15 mi. W. Durango, river outwash area, 74-07-17, ME & PD Perkins (2 PDP). Morcillo, Lake Pena del Aquila, 64-06-28, P.J. Spangler (9 USNM). Hidalgo: Pachuca, 64-08-21, P.J. Spangler (25 USNM). Jalisco: 15 mi. NE Atenquique, 48-12-05, H.B. Leech (13 CAS). 15 mi. N. Chapala, 63-08-02, P.J. Spangler (4 USNM). MExico: Chapingo, en arena del rio, 59-02-01, I. Martell (19 USNM). 11 mi. E. Texcoco, desert stream, 74-05-23, ME & PD Perkins (2 PDP). Michoacan: Patzcuaro, 64-07-07, P.J. Spangler (1 USNM). Morelia, 64-07-08, P.J. Spangler (1 USNM). Puebla: Acatlan, 65-08-25, P.J. Spangler (1 USNM). San Luis Potosi: 2 mi. S. San Luis Potosi, 48-11-21, H.B. Leech (1 CAS). Tamaulipas: Nr. San Antonio, 69-07-27, F.N. Young (29 FNY). Zacatecas: no date, Wickham (2 MCZ). 13 mi. S. Jalpa, stream in desert, 74-07-16, ME & PD Perkins (2 PDP). 29 mi. SW Zacatecas, stream in desert, 74-07-16, ME & PD Perkins (1 PDP).

Puerto Rico: L. Guanica, 38-05-31, Darlington (7 MCZ). Nr. Fajardo, rt. 194 km 46.7, 61-08-20, Flint & Spangler (120 USNM).

United States: Arizona: Cochise Co.: Bisbee, Wood Cn., U.V. lt., 61-07-03, P. Johnson (1 UA). Coconino Co.: Flagstaff, 53-07-01, B. Malkin & J. Farmer (3 CFMNH). Navajo Co.: Winslow, no date, Wickham (1 MCZ). Pima Co.: Colossal Cave Park, 68-02-18, K. Stephan (1 KS). Arivaca, 70-04-11, K. Stephan (1 KS). Tanque Verde, drift, 58-11-23, Werner-Adachi (1 UA). Arivaca Creek at Arivaca, 52-07-31, H.B. Leech (55 CAS). Tucson, no date, Hubbard & Schwarz (2 USNM). Santa Cruz Co.: Pajarito Mts., Sycamore Cyn., 68-08-24, K. Stephan (1 KS). Yuma Co.: Alamo Crossing, u.v. lt., 62-07-14, Werner & Johnson (1 UA). Ft. Yuma, no date, Hubbard & Schwarz (1 USNM). Florida: Brevard Co.: Titusville, 11-11-08, no collr. (1 CAS). Hillsborough Co.: Tampa, no date, F.C. Bowditch (3 MCZ). Orange Co.: No site, no date, no collr. (2 ASP). Volusia Co.: Enterprise, no date, no collr. (3 ASP). Enterprise, no date, F.C. Bowditch (2 MCZ). Enterprise, no date, Hubbard & Schwarz (4 USNM). Lake Harney, no date, Hubbard & Schwarz (2 USNM). New Mexico: Bernalillo Co.: Albuquerque, no date, Hubbard & Schwarz (3 USNM). No site, no date, no collr. (2 OSU; 2 ASP; 2 MCZ; 3 USNM). Oklahoma: Marshall Co.: UOBS, Lake Texoma, Willis, at light, 68-07-09, W. Suter (1 USNM). Texas: Bear Co.: San Antonio, no date, Wickham (1 ASP). Cameron Co.: Esperza Rch., Brownsville, no date, no collr. (2 CU; 2 USNM). Brownsville, no date, Wickham (1 ASP; 4 USNM; 13 MCZ). Brownsville, 33-06-16, Darlington (28 MCZ). Brownsville, in banana debris, 37-03-11, no collr. (1 USNM). Colorado Co.: Columbus , no date, Wickham (1 USNM). Jeff Davis Co.: Davis Mts., 71-02-01, K. Stephan (3 KS). Davis Mts., Limpia Creek Canyon, 52-09-05, B. Malkin (1 CDMNH). Val Verde Co.: Del Rio, no date, no collr. (1 CAS).

19. *Gymnochthebius falli* new species

Map: Figure 94B
Paratypes: 39
United States: Arizona: Maricopa Co.: Salt Creek, no date, Wickham (2 USNM). Idaho: Twin Falls Co.: Magic Hot Springs, 57-07-20, B. Malkin (1 UWA). Kansas: Logan Co.: Same data as Holotype (2 CAS; 2 MCZ; 2 CNC; 29 USNM). Texas: Jeff Davis Co.: Limpia Creek, 74-06-26, H.P. Brown (1 PDP).

20. *Gymnochthebius laevipennis* (LeConte)

Map: Figure 94B
Specimens examined: 23
Mexico: Baja California: Arroyo de la Purisima, 1 mi. upstream from town, 58-12-27, H.B. Leech (4 CAS). Norte, Estero at mouth Arroyo del Rosario, no date, H.B. Leech & P.H. Arnaud (1 CAS).

United States: California: Riverside Co.: Riverside, no date, F.E. Winters (2 CU: 5 CAS). San Jacinto, no date, F.E. Winters (2 MCZ). San Jacinto Mts., no date F.E. Winters (5 USNM). San Diego Co.: Oceanside, Camp Pendleton, 45-10-18, H.P. Chandler (1 CAS). Santa Barbara Co.: Santa Barbara, no date, F.E. Winters (1 CAS). Unspecified Co.: No site, no date, no collr. (1 ASP). Oregon: Douglas Co.: Glendale, 38-07-14, M.H. Hatch (1 UWA).

1. *Ochthebius pacificus* new species

Map: Figure 101A
Paratypes: 230
United States: California: Glenn Co.: 0.5 mi. W. Newville, N. fork Stony Cr., 66-04-04, H.B. Leech (1 CAS). Trib. to Stony Cr., 7 mi. N. Stonyford, 56-03-29, H.B. Leech (5 CAS). Humboldt Co.: Bear River at Capetown, 65-10-01, H.B. Leech (4 CAS). South Eel River at Weott, 155', 70-08-30, H.B. Leech (37 CAS). Willow Cr. just about its E. fork, 1500', 70-08-29, H.B. Leech (8 CAS). North Dobbyn Cr., Alderpoint, Blocksburg Rd., 450', 68-07-19, H.B Leech

(4 CAS). Mendocino Co.: 5.5 mi. SE Boonville, Rancheria Cr., 50-06-15, H.B. Leech (2 CAS). 8 mi. W. Navarro, Navarro River, 50-06-15, H.B. Leech (7 CAS). Cummisky Cr. at Mt. House-Hopland Rd., 64-10-10, H.B. Leech (14 CAS). Dry Cr., Hwy. 128, 64-09-05, H.B. Leech (9 CAS). 2 mi. S. Yorkville, tiny stream, 54-07-25, H.B. Leech (1 CAS). 2 mi. NW Philo, Hendy Woods State Park, 64-07-22, P. Rubtzoff (1 CAS). Garcia River at Hwy. 1, 64-10-12, H.B. Leech (9 CAS). 4.5 mi. NW of Lanes, 60-08-05, H.B. Leech (5 CAS). Pieta Cr. at Route 101, Pieta, 465', 70-08-81, H.B. Leech (1 CAS). No site, no date, Van Dyke (1 CAS). Monterey Co.: Carmel River, 50-08-20, P.S. Bartholomew (6 CAS). Little Sur River, vic. P. Ocean, 70-09-06, P.D. Perkins (25 PDP). Carmel, 56-09-21, B. Malkin (61 CFMNH). Carmel, 53-06-28, B. Malkin (1 CFMNH). Napa Co.: Wheatfield Br. of Burton Cr., Pope Valley, 64-05-10, H.B. Leech (2 CAS). Pope Cr. at Walter Springs Rd., 520', 64-08-24, H.B. Leech (1 CAS). Santa Barbara Co.: Santa Barbara, no date, F.E. Winters (2 CAS). Siskiyou Co.: Stream flowing into Meeks Meadow Lake, 6.25 mi. airline SW Etna, 72-08-23, H.B. Leech (1 CAS). Sonoma Co.: Sonoma, 50-04-29, H.B. Leech (7 CAS). Gualala River at bridge, Annapolis & Stewarts Point-Healdsburg Rd., 64-09-07, H.B. Leech (3 CAS). Duncan Mills, 08-07-09, F.E. Blaisdell (2 CAS). Cloverdale, 26-09-19, V.S. Brown (7 CAS). The Geysers, 70-09-07, P.D. Perkins (5 PDP). Trinity Co.: Hayfork Cr. at bridge near Carrier Gulch, Wildwood R., R., 72-08-07, H.B. Leech (3 CAS). Trinity River at Big Flat, 60-08-04, H.B. Leech (3 CAS). Nevada: Clark Co.: 15 mi. S. Overton, spring, 66-03-31, J. Schuh (1 JS). Oregon: Douglas Co.: Glendale, 38-06-14, M.H. Hatch (2 UWA). Lincoln Co.: Newport, seepage area, 63-05-04, T. Schuh (2 JS). Washington: King Co.: Cedar Mt., 40-05-09, M.H. Hatch (1 UWA).

2. *Ochthebius arenicolus* new species

Map: Figure 101B

Paratypes: 320

Mexico: Baja California: La Suerte, Sierra San Pedro Martir, pool in canyon, 3700', 63-06-04, R.K. Benjamin (121 CAS). 17 mi. W. Bahia de Los Angeles, 62-05-29, R. & E. Ryckman and C. Christianson (8 CAS).

United States: California: Colusa Co.: Trib. of E. branch Little Indian Cr., 6.2 mi. S. Lodoga, 66-04-04, H.B. Leech (29 CAS). Indian Cr., 1.5 mi. along road to Cooks Springs, SW of Lodoga, 71-10-10 H.B. Leech (29 CAS). Indian Cr., Cooks Springs, 4 air mi. SW Lodoga, 1480', 71-07-03, H.B. Leech, (25 CAS). Trib. to Bear Cr., Robbers Flat below Brim Grade, 419 m., 71-10-10, H.B. Leech (1 CAS). Wilbur Springs, 1250', 71-07-17, P.D. Perkins (6 PDP). Contra Costa Co.: Berkeley, 42-06-07, W. Cook (1 CAS). Marsh Creek, 37-04-10, H.B. Leech (1 CAS). Del Norte Co.: No site, 10-06-01, Nunenmacher (1 CFMNH). Humboldt Co.: Bear R. at Capetown, 65-10-01, H.B. Leech (1 CAS). Burr Cr., 3 mi. S. of Bridgeville, 1200', 68-07-19, H.B. Leech (1 CAS). Mill Cr., 7.5 mi. S. of Bridgeville, 1200', 68-07-19, H.B. Leech (2 CAS). N. Fork Yager Cr. at Bridgeville-Kneeland Rd., 1300', 66-08-08, H.B. Leech (1 CAS). Lake Co.: Bear Cr. at Crabtree Hot Springs Rd., 55-08-04, H.B. Leech (1 CAS). Creek behind Cottage City resort, Lucerne, 53-07-05, H.B. Leech (4 CAS). 6.9 mi. N. Middletown, on h'way 29, 55-02-20, H.B. Leech (1 CAS). Marin Co.: Redwood Cr., 1.8 mi. S. Muir Woods Nat'l. Mon., 64-10-03, H.B. Leech (1 CAS). Mendocino Co.: McDowell Cr., just below Oasis, 1800', 55-07-27, H.B. Leech (2 CAS). Beebe Cr., 55-09-05, H.B. Leech, (6 CAS). Parson Cr., 4.5 mi. NE of Hopland, 64-06-30, H.B. Leech (1 CAS). Black Butte River, just above mouth, 68-07-17, H.B. Leech (1 CAS). Bear Pen Cyn, Cr., just above junction with Burger Creek Dos Rios-Laytonville Rd., 72-08-30, H.B. Leech (1 CAS). Monterey Co.: Lewis Cr., 52-08-29, H.B. Leech (6 CAS). Nacimiento R., Ponderosa Public Camp, 70-09-06, P.D. Perkins (3 PDP). Riverside Co.: Salton, no date, Hubbard and Schwarz (8 USNM). San Benito Co.: Griswold Cr., Lyons Canyon on road to Idria, 63-07-21, H.B. Leech (7 CAS). San Luis Obispo Co.: Lopez Canyon Dam outlet, 71-09-05, P.D. Perkins (2 PDP). Santa Barbara Co.: Santa Barbara, no date, F.E. Winters (1 CAS). 1 mi. S. San Marcos Pass, 2000', 70-06-27, P.D. Perkins (1 PDP). Santa Ynez R., Juncal Public Camp, 70-04-27, P.D. Perkins (1 PDP). Brookshire Spr., 7 mi. E. Pine Cyn. Ranger Sta., 1500', 72-06-18, P.D. Perkins (1 PDP). Stanislaus Co.: Del Puerto Cr., 4 mi. by road W. of Freeway Route No. 5, 71-09-03, H.B. Leech (17 CAS). Trinity Co.: S. Fork Trinity R., Salmon Rock Camp, Hyampon-Big Slide Rd., 68-07-23, H.B. Leech (1 CAS). Ventura Co.: Sespe Cr., Sespe Gorge, 3500', 72-06-18, P.D. Perkins, (1 PDP). Ojai Valley, no date, Hubbard and Schwarz (1 USNM). Ventura, no date, Fall (2 MCZ). Unspecified Co.: No site, no date, no collr. (1 ASP). Oregon: Curry Co.: Pistol R., 56-09-17, B. Malkin (8 CFMNH).

3. *Ochthebius lecontei* new species

Map: Figure 99A

Paratypes: 44

Canada: British Columbia: Vernon, 29-07-06, H.B. Leech (1 CAS). Vernon, 37-09-11, H.B. Leech (1 CAS). Vernon, Ski-jump pond, 41-04-19, H.B. Leech (1 CAS). Vernon, Pond 3, 41-04-20, H.B. Leech (14 CAS; 2 CNC). Kamloops, 39-08-20, G.J. Spancer (8 CAS). Cranbrook, 56-08-12, G. Stace Smith (2 UBC).

United States: Montana: Madison Co.: Ziegler Hot Spgs., 52-07-27, B. Malkin (6 CFMNH). Nevada: Elko Co.: Thousand Springs Cr., Route 30, 9 mi. NE Montello, 69-08-26, H.B. Leech (1 CAS). Wells, no date, C.T. Brues (6

MCZ). No site, no date, Van Dyke (1 CAS). Utah: Beaver Co.: Milford, no date, Wickham (1 MCZ).

4. *Ochthebius interruptus* LeConte

Map: Figure 101C

Specimens examined: 692

Canada: British Columbia: Vancouver, no date, no collr. (7 ASP).

Mexico: Baja California: La Salina, 4 mi. S. La Mision de San Miguel, 61-05-21, I. Moore (19 CAS). Norte, 8 mi. upstream from Hamilton Ranch, dam site, 63-04-23, H.B. Leech (1 CAS). Norte, Estero at mouth Arroyo del Rosario, no date, H.B. Leech and P.H. Arnaud, Jr. (1 CAS). Norte, 3.2 mi. S. Colonia Guerrero, 63-04-24, H.B. Leech (17 CAS). Norte, Mision de San Miguel, on mud, salt flat, 59-06-27, I. Moore (41 CAS). Norte, La Salina, 71-08-20, I. Moore (1 USNM). Norte, La Mision de San Miguel, salt marsh, 71-10-05, I. Moore (33 UCR). Norte, La Salina, salt marsh, 71-10-09, I. Moore (243 UCR). Mision de San Miguel, 61-05-21, I. Moore (1 CNC).

United States: California: Alameda Co.: Alameda, 22-03-07, no collr. (6 CAS). Bay Farm Island, 22-03-07, no collr. (1 UI). Arroyo d. Valle, 72-03-06, W.H. Tyson (8 RG). 2 mi. NE Livermore, 60-07-09, no collr. (1 UCB). 10 mi. E. Livermore, 59-03-14, D. Burdick (1 UCB). No site, 06-06-01, F. Nunenmacher (5 CFMNH). Colusa Co.: Indian Cr., 1.5 mi. along road to Cooks Springs SW of Lodoga, 71-10-10, H.B. Leech (2 CAS).V Contra Costa Co.: Vine Hill, 13-06-07, F.E. Blaisdell (3 CAS). Albany, tide pool, 21-04-23, C.J. Dodds (8 CAS). Albany, 21-03-16, no collr. (3 CAS). Danville, 51-06-01, F.X. Williams (3 CAS). Martinez, no date, Wickham (4 USNM). Albany, tide pool, 21-02-26, no collr. (2 UI). Glenn Co.: N. Fork Stony Creek, 0.5 mi. W. of Newville, 66-04-04, H.B. Leech (9 CAS). Trib. to Stony Cr., 7 mi. N. Stonyford, 53-03-29, H.B. Leech (23 CAS). Kings Co.: Stratford, 50-08-21, P.S. Bartholomew (1 CAS). Lake Co.: Clear Lake State Park, wet edge of Clear Lake, 64-11-10, P. Rubtzoff (1 CAS). Los Angeles Co.: Redondo, 44-06-07, G.P. Mackenzie (6 CAS; 1 CU). Redondo, 44-05-24, G.P. Mackenzie (4 CNC; 4 UA). Redondo, no date, no collr. (4 SDSU; 2 CFMNH). Redondo, no date, A. Fenyes (4 CU; 1 USNM). Redondo, no date, H.C. Fall (2 CAS). Los Angeles, no date, no collr. (3 CAS). L. Redondo, no date, F. Winters (8 CAS). Tejon Pass, 18-07-28, J.O. Martin (5 CAS). Pomona, no date, no collr. (6 CNC). Marin Co.: Smiths Lake, Manor, 55-11-21, H.B. Leech (3 CAS). Headwaters of Salmon Cr., Wilson Hill road, 64-02-22, H.B. Leech (1 CAS). Dipsea, no date, F.E. Blaisdell (1 CAS). Mendocino Co.: N. Branch Mill Cr., Covelo-Paskenta road near Covelo, 68-07-17, H.B. Leech (8 CAS). Napa Co.: Burton Cr., Pope Valley, 64-05-10, H.B. Leech (1 CAS). Pope Creek at Walter Springs road, 520', 64-08-24, H.B. Leech (1 CAS). Orange Co.: San Juan, 17-08-13, no collr. (1 CAS). Laguna Beach, no date, no collr. (2 CAS). Riverside Co.: Sonorian Region, no date, F.E. Winters (4 CAS). Riverside, no date, F.E. Winters (4 CAS). Elsinore Lake, 17-09-01, J.O. Martin (3 CAS). San Jacinto Mts., no date, F.E. Winters (2 CAS). San Benito Co.: Farm pond, Mendota-Hollister road at Panoche Pass, 63-07-21, H.B. Leech (32 CAS). San Diego Co.: Oceanside, 45-10-23, H.P. Chandler (1 CAS). 1 mi. S. Carlsbad, 68-08-28, P.S. Bartholomew (1 CAS). San Diego, 17-08-17, J. O. Martin (3 CAS). Mission Valley, 35-08-19, I. Moore (2 CAS). Torrey Pines, edge of Soledad Canyon, Lagun, 50-08-06, I. Moore (1 CAS). Camp Pendleton, Oceanside, 45-10-26, H.P. Chandler (1 CAS). San Luis Obispo Co.: Lopez Canyon Dam outlet, 70-09-05, P.D. Perkins (4 PDP). Santa Barbara Co.: Santa Inez Mts., Santa Barbara, no date, F.E. Winters (3 CAS). Santa Barbara, no date, F.E. Winters (12 CAS; 1 USNM; 3 CU). Montecito, no date, F.E. Winters (5 CAS). Santa Cruz Island, no date, F.E. Winters (1 CAS). Santa Cruz Co.: Seabright, 24-07-18, F.E. Blaisdell (4 CAS; 8 ASP). Santa Cruz, 37-11-15, J.W. Tilden (4 CAS). Sonoma Co.: Guerneville, 08-07-23, F.E. Blaisdell (2 CAS). Yolo Co.: Woodland, 33-05-22, E.C. Zimmerman (1 USNM). Unspecified Co.: No site, no date, no collr. (5 USNM; 4 UW; 8 ASP; 3 SDSU). No site, no date, F.C. Bowditch (8 MCZ). Oregon: Crook Co.: 5 mi. S. Suplee, Weburg Ranch, hot springs, temp. 100 degrees F., 62-09-07, K. Goeden (5 ORSU). Harney Co.: Hot Spgs. SE shore Harney Lake, 51-06-20, B. Malkin (5 UWA; 3 CFMNH). 1 mi. S. Harney Lake, hot springs, 56-05-18, J.D. Lattin (7 ORSU). 1/2 mi. S. Harney Lake, margins of hot springs, 61-06-30, K. Goeden (5 ORSU). 20 mi. W. Malheur Lake, hot springs, 56-05-18, K. Goeden (2 ORSU). Lake Co.: fresh pool, SE shore L. Albert, 50-07-17, H.B. Leech (1 CAS). Abert Lake,57-04-28, J. Schuh (3 UWA; 3 JS). Malheur Co.: Sucker Cr. at hiway. 95, 56-07-20, H.B. Leech (2 CAS). Washington: Grant Co.: Grand Coulee, Tule Lake, 46-05-11, M.H. Hatch (1 UWA). Upper Grand Coulee, 36-04-26, M.H. Hatch (1 UWA). Pacific Co.: Tokeland, 29-07-10, no collr. (13 UWA). Skagit Co.: Anacortes, brackish pond, 61-05-20, D.V. McCorkle (2 UWA).

5. *Ochthebius sierrensis* new species

Map: Figure 99A

Paratypes: 15

United States: California: Calaveras Co.: Mokelumne Hill, 10-07-18, F.E. Blaisdell (5 CAS). Fresno Co.: Squaw Valley Cr., 55-06-26, P.S. Bartholomew (7 CAS). Kings River Camp, 50-08-23, P.S. Bartholomew (3 CAS).

6. *Ochthebius lineatus* LeConte

Map: Figure 107

Specimens examined: 1,690

Canada: Alberta: Medicine Hat, many dates, F.S. Carr (24 CAS; 2 USNM; 5 UWA; 4 MCZ; 8 UA). Medicine Hat, 24-08-31, H. Wenzel (20 OSU). Highwood Valley, cataract Creek, 64-07-16, H.B. Leech (1 CAS). Hussar, 28-05-20, O. Bryant (5 CAS). Tilley, 34-06-25, J. Carr (3 CAS). Castor, no date, no collr. (1 OSU). British Columbia: Kamloops, Lac du Bois, Lone Rock Narrows Pool, 43-07-08, G. J. spencer (2 CAS). Creston, Goat River, many dates, G. Stace-Smith (3 UWA; 11 UBC). Copper Mtn., 30-08-24, G. Stace-Smith (2 CNC; 1 UBC). Summerland, 33-06-01, A.N. Gartrell (1 CNC). Kamloops, no date, Wickham (1 ASP). 17 mi. W. Hedley, 59-05-31, R.E. Leech (2 CNC). Manitoba: Winnipeg, 16-09-23, J.B. Wallis (3 CNC). Stonewall, 20-05-02, J.B. Wallis (1 CNC). St. Norbert, 17-09-22, J.B. Wallis (1 CNC). Saskatchewan: Saskatoon, 70-09-19, E.J. Kiteley (2 EJK). Elbow, 50-06-03, A.R. Brooks (1 CNC).

Colombia: Magdalena: 8 km. E. Barranquilla, 69-03-19, P. & P. Spangler (5 USNM). Atlantico: Barranquilla, 69-03-18, P. & P. Spangler (5 USNM).

Mexico: Baja California: Arroyo de la Purisima, 1 mi. upstream from town, 58-12-27, H.B. Leech (3 CAS). Mexicali, 42-10-28, no collr. (2 USNM). Chihuahua: Cd. Jiminez., 64-06-26, P.J. Spangler (1 USNM). Nayarit: Tepic, 53-09-24, B. Malkin (1 USNM). Oaxaca: Salina Cruz, 64-07-23, P.J. Spangler (13 USNM). Tehuantepec, 64-07-23, P.J. Spangler (1 USNM). Sinaloa: Los Mochis, 22-06-13, C.T. Dodds (76 CAS). Los Mochis, 13 mi. N., 64-08-07, Chemsak & Powell (1 UBC). Sonora: Hermosillo, 53-07-16, B. Malkin (93 CAS). Hermosillo, 55-05-25, B. Malkin (1 UBC). Alamos, 63-02-22, P.H. Arnaud, Jr., (92 CAS). 7 mi. SE Alamos, 71-11-27, K. Stephan (6 KS). Alamos, 7 mi. W., 64-08-08, Chemsak & Powell (1 UBC). 40 mi. SE Guaymas, no date, K. Stephan (6 KS). 16 mi. NE Cd. Obregon, 61-05-14, Howden & Martin (1 CNC). 10 mi. NE Cd. Obregon, 64-08-10, Howden & Lindquist (1 CNC).

United States: Arizona: Cochise Co.: Wilcox Playa, 69-11-02, K. Stephan (1 KS). Gila Co.: Globe, 49-08-01, F.H. Parker (8 UA). Porter Springs, Roosevelt Lake, 28-02-22, no collr. (4 CNC). Maricopa Co.: Phoenix, no date, no collr. (4 OSU). Navajo Co.: Winslow, no date, Wickham (1 MCZ; 2 USNM). Pima Co.: Tucson, no date, Hubbard & Schwarz (1 USNM). Colossal Cave Park, 68-02-18, K. Stephan (2 KS). Santa Cruz Co.: Patagonia, 36-07-01, E.S. Ross (1 CAS). Yuma Co.: Tacna, no date, Hubbard & Schwarz (1 USNM). Yuma, 59-06-01, D. Muse (1 UA). Yuma, 59-03-30, D. Muse (4 UA). Yuma, 61-07-24, D. Tuttle (2 UA). Alamo Crossing, u. v. lt., 62-07-14, Werner & Johnson (2 UA). Unspecified Co.: No site, no date, no collr. (2 CAS; 1 ASP; 1 MCZ). California: Alameda Co.: 10 mi. E. Livermore, 59-03-14, D. Burdick (1 UBC). No site, 06-08-01, F. Nunenmacher (1 CFMNH). Colusa Co.: Indian Cr., 1.5 mi. along road to Cooks Springs, SW of Lodoga, 71-10-10, H.B. Leech (1 CAS). Contra Costa Co.: No site, 38-05-01, J. Blum (3 OSU). Imperial Co.: Imperial Valley, 11-02-01, F.E. Blaisdell (22 CAS). Imperial Cr., Imperial Valley, 11-02-01, no collr. (4 USNM). El Centro, 27-12-06, F.E. Blaisdell (5 CAS). El Centro, 11-01-01, J.C. Bridwell (5 USNM). La Puerta, 11-02-01, no collr. (39 CAS). Seeley, 45-02-16, Anderson & Hanson (4 USNM). No site, 22-06-06, F.E. Blaisdell (3 CAS0. Kern Co.: Poso Creek, no date, no collr. (8 CAS). Lake Co.: Hidden Lake, 4 mi. NW of Lakeport, 55-08-05, H.B. Leech (1 CAS). Rocky Point, Clear Lake, 46-05-08, H.P. Chandler (1 CAS). L. Pillsbury, Eel River, 2000', 46-10-09, H.P. Chandler (1 CAS). Lassen Co.: Martins Springs, 22-08-08, J.O. Martin (1 CAS). Los Angeles Co.: Tejon Pass, 18-07-28, J.O. Martin (12 CAS). Los Angeles, no date, no collr. (1 CAS). No site, no date, no collr. (1 CAS). Marin Co.: Dipsea, 08-06-01, F.E. Blaisdell (1 CAS). No site, no date, no collr. (1 CAS). Mono Co.: Poore Lake, 7514', 63-08-14, H.B. Leech (5 CAS). Overflow pond N. site, Poore Lake, 7200', 63-08-14, H.B. Leech (5 CAS). Round pond on ridge S. of Leavitt Mdw., 7500', 63-08-13, H.B. Leech (1 CAS). W. Walker River, 52-08-16, P.S. Bartholomew (2 CAS). Orange Co.: Laguna Beach, rock crevice, tidewater, 31-02-12, F.E. Winters (2 CAS). Riverside Co.: Colorado River, no date, F.E. Winters (10 CAS). Palm Canyon, 16-04-15, J.O. Martin (1 CAS). Riverside, no date, F.E. Winters (4 CAS; 1 OSU; 1 MCZ). San Bernardino Co.: San Bernardino Mts., no date, no collr. (1 CAS). Needles, no date, no collr. (5 CAS). Santa Inez Mts., Santa Barbara, no date, F.E. Winters (1 OSU). The Needles, no date, no collr. (1 ASP). Needles, no date, Wickham (4 MCZ). San Francisco Co.: No site, 15-03-21, no collr. (1 CAS). San Joaquin Co.: Near Lodi, 31-04-20, F.E. Blaisdell (1 CAS). Santa Barbara Co.: Santa Barbara, no date, F.E. Winters (2 CAS). Shasta Co.: Hat Creek R.S., 3000', 47-06-28, H.P. Chandler (1 CAS). Siskiyou Co.: 6 mi. S. Macdoel, 58-03-24, J. Schuh (1 JS). 6 mi. S. Macdoel, edge of pond, 66-10-07, J. Schuh (1 JS). Sutter Co.: 8 mi. W. Live Oak, 62-05-30, J. Doyen (1 UCB). Tulare Co.: Kern River, 9.5 road mi. N. of Kernville, 70-03-25, H.B. Leech (1 CAS). Colorado: Routt Co.: Steamboat Springs, 47-07-01, O. Bryant (1 CAS). Mesa Co.: Black Ridge, 5 mi. N. Glade Park, 68-07-14, H.F. Howden (1 CNC). Moffat Co.: Deception Creek, 2 mi. E. Maybell, 5910', 67-07-13, H.B. Leech (4 CAS). Weld Co.: Greeley, no date, no collr. (1 USNM). Idaho: Bear Lake Co.: Montpelier, swamp, 52-07-10, B. Malkin (2 UWA; 2 CFMNH). Bonner Co.: Pen d'Oreille R., Sand Point, 37-06-20, no collr. (9 UWA). Cassia Co.: Sublett Reservoir, 52-07-13, B. Malkin (60 CAS, 3 UWA, 3 CFMNH). Custer Co.: Salmon River, 12 mi. N. Challis, 52-07-24, B. Malkin (8 UWA; 8 CFMNH). Jefferson Co.: Camas Wildlife Refuge, 52-07-27, B. Malkin (3 UWA; 3 CFMNH). Twin Falls Co.: Magic Hot Springs, 52-07-20, B. Balkin (2 UWA; 2 CFMNH). Valley Co.: Donnelly, 52-08-30, W.F. Barr (2 UI; 1 UWA). Kansas: Logan Co.: McAllister, 56-08-29, P.J. Spangler (84 USNM). Montana: Dawson Co.: Glendive, no date, Hubbard & Schwarz (4 USNM; 16 CAS). Flathead Co.: Kalispell, 20-06-13, Wickham

(12 USNM; 4 MCZ). Madison Co.: Ziegler Hot Springs, 52-07-27, B. Malkin (10 CFMNH). Nebraska: Thomas Co.: Neb. Nat'l, Forest, 2.5 mi. W. Halsey, 67-07-16, H.B. Leech (1 CAS). Nevada: Ormsby Co.: Carson City, no date, Wickham (1 MCZ). New Mexico: Bernalillo Co.: Albuquerque, no date, no collr. (2 CFMNH; 2 UW; 2 CU; 1 ASP; 13 CAS). Albuquerque, no date, Wickham (2 USNM). No site, no date, no collr. (12 USNM; 5 UW; 4 CFMNH; 8 OSU; 2 CNC; 3 CU; 13 MCZ). Dona Ana Co.: Mesilla Dam, 24-04-25, J. O. Martin (22 CAS). North Dakota: Adams Co.: No site, 63-09-04, R. Gordon & R. Post (1 RG). Benson Co.: Pleasant Lake, springfed pond, 68-08-16, R. Gordon (1 USNM). Bottineau Co.: Lake Metigoshe, 63-05-23, R. Gordon (4 RG). No site, 62-07-15, R. Gordon (1 RG). Burke Co.: No site, 63-05-23, R. Gordon (24 RG). Burleigh Co.: No site, 63-09-03, R. Gordon & R. Post (1 RG). Cass Co.: Fargo, 66-07-30, R. Gordon (3 RG). Divide Co.: No site, 63-05-23, R. Gordon (1 RG). Dunn Co.: Killdeer Mts., 63-05-22, R. Gordon (1 RG). Eddy Co.: Lake Coe, 66-06-24, R. Gordon (1 RG). Foster Co.: No site, 63-05-03, R. Gordon (5 RG). Grand Forks Co.: 5 mi. S. Niagara, 66-07-08, R. Gordon (1 RG). Northwood, Goose River, 66-07-08, R. Gordon (22 RG; 1 CAS). Grant Co.: Lake Tschida, 66-05-21, R. Gordon (3 RG). Hettinger Co.: No site, 62-09-12, R. Gordon (1 RG). Mchenry Co.: No site, 62-09-11, R. Gordon & R.L. Post (1 RG; 2 CAS). Ransom Co.: T.135N R.52W Sec. 14NW, 66-08-05, R. Gordon (1 RG). Renville Co.: Sherwood, 66-05-29, R. Gordon (22 RG). Richland Co.: Mirror Pool, 68-08-22, R. Gordon (1 USNM). T.135N R.52W Sec.5, 68-08-22, no collr. (13 USNM). No site, 64-08-19, R. Gordon (3 RG). Rolette Co.: Dunseith, junct. Hwy. 3 & 43, .5 mi. W., 70-06-06, R. Gordon (2 RG). Sargent Co.: Tewaukon Ref. Headq. spring, 68-08-23, R. Gordon (6 USNM). Slope Co.: Chalky Buttes, 65-06-07, W. Kotchman (2 CAS). No site, 62-09-13, R. Gordon & R.L. Post (1 RG; 5 USNM; 2 CAS). Traill Co.: Mayville, Goose River, 65-09-24 (3 RG). Wells Co.: Fessenden, James River, 66-06-24, R. Gordon (2 RG). Williams Co.: Willist'n, 09-06-08, Wickham (1 UW; 1 USNM; 12 CAS). Willist'n, 33-06-08, Wickham (1 RG). Oklahoma: Woods Co.: 3 mi. W. Waynoka, old road to Herman, 67-08-11, H.B. Leech (2 CAS). Oregon: Benton Co.: Corvallis, small pond, 56-04-08, K. Goeden (1 ODA). Harney Co.: Steens Mts, Fish Lake, 7500', 51-06-26, B. Malkin (1 UWA). Klamath Co.: Bly Mts., 45-06-13, K.M. Fender (1 UWA). Sprague R., 12 mi. E. Chiloquin, 51-07-03, B. Malkin (26 UWA). Bly, 45-06-13, K.M. Fender (3 UWA). Barkley Springs, 59-09-08, J. Schuh (2 UWA). 8 mi. NE (air) Klamath Falls, black-lite trap, 65-07-03, K. Goeden (1 ODA). Hog Cr., E. side of Solomon Flat, 68-04-06, J. Schuh (15 JS). Poe Valley, temporary pond, 66-05-13, J. Schuh (82 JS). Klamath Falls, Modoc Point, in pond, 55-06-01, J. Schuh (1 JS). Klamath Falls, above Geary Ranch, sweeping swamp, 61-05-17, J. Schuh (2 JS). Barkley Springs, 59-09-08, J. Schuh (5 JS). Kirk, Williamson River, shore, 66-10-02, Schuh, Scott & Gray (1 JS). Upper Klamath Marsh, Jackson Cr., 65-09-25, J. Schuh (1 JS). Head of Spring Cr., 65-08-16, J. Schuh (1 JS). Sprague River, 12 mi. E. Chiloquin, 51-07-01, B. Malkin (24 CFMNH). Barkley, 74-07-03, Gordon & Schuh (1 RG). Spring Creek Campground, 74-07-02, R. Gordon (2 RG). Chewaucan River near Valley Falls, 39-08-16, Gray & Schuh (1 CAS; 1 ORSU). Lakeview, 51-06-28, B. Malkin (1 UWA). Chewaucan R., dam site, 55-06-18, J. Schuh (1 JS). Chewaucan R. near Valley Falls, 55-06-06, J. Schuh (1 JS). Malheur Co.: Sucker Creek Canyon, 51-06-18, B. Malkin (3 CFMNH; 5 UWA). Owhhee River, 3 mi. SE Rome, 3500', 64-07-14, T. Schuh & J. Lattin (1 ORSU). Wasco Co.: The Dallas, 54-04-07, S. & M. Sargent (1 UWA). Yamhill Co.: Dayton, 41-09-07, K.M. & D.M. Fender (2 UWA). McMinnville, 48-07-15, K.M. & D.M. Fender (4 UWA). 4 mi. S. Newberg, black-lite trap, 69-08-11, no collr. (1 ODA). South Dakota: Beadle Co.: Wolsey, 3 mi. NW. 40-06-20, G. Spawn (4 SDAU). Brown Co.: Houghton, 6 mi. SE 40-06-21, H. Severin (2 SDSU). Aberdeen, 39-09-24, G. Spawn (11 SDSU). Groton, 17 mi. N., 40-06-20, H. Severin (6 SDSU). Houghton, 8 mi. W., 41-06-14, H. Severin (3 SDSU). Brookings Co.: Lake Oakland, 4 mi. N., 39-08-11, G. Spawn (60 SDSU). Day Co.: Roslyn, 39-09,14, H. Severin (3 SDSU). Waubay Refuge, alkalia water, 40-06-22, H. Severin (2 SDSU). Deuel Co.: Clear Lake, 39-09-15, H. Severin (1 SDSU). Fall River Co.: Hot Springs, 6 mi. S., 40-06-22, H. Severin (1 SDSU). Hot Springs, 61-07-09, H. & A. Howden (1 CNC). Angostura Dam, S. of Hot Springs, 68-07-06, H.F. Howden (1 CNC). Smithwick, 40-06-21, H. Severin (3 SDSU). Gregory Co.: Burke, 40-06-11, H. Severin (1 SDSU). Haakon Co.: Phillip Junction, 40-09-07, H. Severin (6 SDSU). Dam Phillip, 40-09-07, H. Severin (2 SDSU). Jackson Co.: Belvidere, 10 mi. E., 39-09-24, G. Spawm (13 SDSU). Kingsbury Co.: Arlingon, pothole, 39-06-19, H. Severin (6 SDSU). Lawrence Co.: Spearfish Creek, 3 mi. N. Spearfish, 71-06-09, E.U. Balsbaugh, Jr. (1 SDSU). Lincoln Co.: Canton, 1 mi. W., gravel pit, 40-08-20, G. Spawn (1 SDSU). Lyman Co.: Vivian, Reeds Ranch, 40-07-11, H. Severin (4 SDSU). Kennebec, 2 mi. W., 40-06-20, H. Severin (8 SDSU). McPherson Co.: Leola, 14 mi. NW. 40-06-25, H. Severin (13 SDSU). Mellette Co.: Wood, 39-07-23, H. Severin (37 SDSU). Pennington Co.: Black Hills, Cheyenne Xing, 66-06-18, R. Gordon (2 RG). Hill City, 10 mi. S., 40-06-22, H. Severin (1 SDSU). Dam Wall, 40-09-07, H. Severin (2 SDSU). Larive Lake, cold brook, 40-06-22, H. Severin (1 SDSU). Roberts Co.: Ortley, 7 mi. N., 40-07-24, H. Severin (3 SDSU). Todd Co.: 9 mi. E. Rosebud, 40-09-05, H. Severin (2 SDSU). Yankton Co.: 3 mi. W. Mission Hill, 40-08-05, H. Severin (3 SDSU). Texas: El Paso Co.: El Paso, 89-11-22, Fall (1 CAS). El Paso, 42-02-14, no collr. (1 USNM). El Paso, no date, no collr. (2 CU; 5 CAS). Jeff Davis Co.: Davis Mts., 71-02-01, K. Stephan (2 KS). Kimble Co.: Junction, 71-02-01, K. Stephan (1 KS). Uvalde Co.: Sabinal, 10-03-01, F.C. Pratt (1 USNM). Utah: Beaver Co.: Milford, no date, Wickham (2 USNM; 3 CAS; 1 MCZ). Cache Co.: Logan Canyon, 7200', 73-07-28, R. Gordon (1 RG). Duchesne Co.: Myton, no date, no collr. (2 CNC; 5 CAS). Utah Co.: Utah Lake, east side, 4000', 41-06-14, H.P. Chandler (12 CAS). Payson Canyon, 7000', 41-06-21, H.P. Chandler (4 CAS). Wayne Co.: Hanksville, 68-08-01, H.F. Howden (10 CNC). 12 mi. S. Hanksville, 68-07-22, H.F. Howden (2 CNC). Washington: Kittitas Co.: Ellensberg, 32-07-19, M.H. Hatch (2 UWA). Ellensberg, 54-09-26, B. Malkin (4 CFMNH). Lincoln Co.: Grand Coulee, Tule Lake, 46-05-11, M.H. Hatch (1 UWA). Grand Coulee, Dry Falls, 37-05-01, M.H. Hatch (1 UWA). Grand Coulee, Dry Falls, 47-05-04,

M.H. Hatch (1 UWA). Spokane Co.: Spokane, 32-08-26, M.H. Hatch (8 UWA). Mead, 32-08-26, M.H. Hatch (3 UWA). Chatteroy, 32-08-26, M.H. Hatch (1 UWA). Cheney, Turnbull Slough, 47-05-30, M.H. Hatch (3 UWA). Whitman Co.: Lancaster, Palouse River, 32-08-27, M.H. Hatch (2 UWA). Wisconsin: Bayfield Co.: Bayfield, no date, Wickham (1 RG). Wyoming: Bighorn Co.: Shell Cr., mouth of Shell Canyon at Shell, 4230', 64-07-25, H.B. Leech (10 CAS). Crook Co.: Devils Tower N. Mon., Belle Fourche River, 62-08-13, P.J. Spangler (57 USNM). Fremont Co.: Burris, 10 mi NW E. fork Wind River, 62-08-23, P.J. Spangler (2 USNM). Goshen Co.: Culvert under Hwy. 26, 3.5 mi. W. of town of Fort Laramie, foul pool, 65-08-19, H.B. Leech (8 CAS). N. Platte River, old Hwy. bridge, 5.3 mi. E. town of Fort Laramie, 65-08-18, H.B. Leech (1 CAS). Hot Springs Co.: Thermopolis, 52-08-03, B. Malkin (1 CFMNH). Natrona Co.: Middle Casper Cr. at Hwy. 20, ca 2.5 mi. Se Natrona, 65-08-20, H.B. Leech (4 CAS). Badwater Cr. at Badwater, NW of Arminto, 65-08-21, H.B. Leech (1 CAS). Dugout Cr., 8.5 mi. NW of Midwest, 64-07-27, H.B. Leech (4 CAS). Platte Co.: Stream under Hwy. 87, 5.8 mi. S. of Glendo, 64-07-29, H.B. Leech (1 CAS). Horseshoe Cr., 2 mi. S. Glendo, 64-07-29, H.B. Leech (1 CAS). Sheridan Co.: Bighorn Nat'l. For. nr. Dayton, Isaac Walton Picnic Area, 62-08-14, P.J. Spangler (2 USNM). Sweetwater Co.: Ox-bow cut-off of Bitter Cr., 10 mi. W. Rock Springs, Hwy. 30, 65-08-23, H.B. Leech (1 CAS). Yellowstone National Park: Yellowstone Park, 8000', no date, no collr. (1 CAS).

7. *Ochthebius marinus* (Paykull)

Map: Figure 109

Specimens examined: 702

Canada: Alberta: 6 mi. S. Pincher Creek, 71-08-01, P.D. Perkins (1 PDP). Medicine Hat, 25-05-08, F.S. Carr (4 UA; 1 CAS). Medicine Hat, 34-06-24, J. Carr (1 CAS). Medicine Hat, 24-08-31, no collr. (1 OSU; 1 PDP). Medicine Hat, 28-08-28, no collr. (7 USNM). Highwood Valley, Cataract Cr., 64-07-16, H.B. Leech (3 CAS). Tofield, 24-05-11, O. Bryant (1 CAS). Edmonton, 24-09-01, O. Bryant (1 CAS). High River, 27-06-01, O. Bryant (1 CAS). Calgary, 45-06-10, E.J. Kiteley (1 EJK). Castor, no date, no collr. (1 OSU). Bittern Lake, 61-08-15, A.M. Brooks (1 CNC). Lusk Creek, 1 mi. E. Kananaskis, F.E.S., 70-08-22, Lindquist (1 CNC). British Columbia: Kamloops, Old Stove Pond, Lac du Bois, 43-07-18, G.J. Spencer (3 CAS). Kamloops, Lac du Bois, Lone Rock, Narrows Pool, 43-07-08, G.J. Spencer (2 CAS). Upper Hat Cr., roadside pool, China Farm, 33-08-29, G. Spencer (1 CAS). Savona Road, 33-07-07, A. Thrupp (1 CAS). Lillooet Dist., Alkali Lake, 30 mi. S. Williams Lake, 71-07-24, P.D. Perkins (5 PDP). Kamloops, no date, Wickham (1 USNM). Summerland, 32-05-28, A.N. Gartrell (1 CNC). Manitoba: Churchill, 30-06-25, O. Bryant (1 CAS). Aweme, 20-07-08, J.B. Wallte (1 CAS). Aweme, 27-08-05, E. Criddle (1 USNM). Treesbank, 4 mi. W. Hwy. 344, 68-08-14, R. Gordon (3 USNM). Churchill, 37-08-18, W.J. Brown (17 CNC). Husavick, 16-07-17, J.B. Wallis (3 CNC). Winnipegosis, no date, J.B. Wallis, (1 CNC). Winnipeg, 22-08-24, J.B. Wallis (1 CNC). Stonewall, 20-05-02, J.B. Wallis (1 CNC). Churchill, 52-08-02, J.G. Chillcott (3 CNC). Onah, 18-07-11, J.B. Wallis (1 MCZ). Winnipeg Beach, 10-07-11, J.B. Wallis (1 MCZ). Aweme, 70-06-09, R. Gordon (1 RG). Saskatchewan: Yorkton, 47-07-27, C.C. Shaw (2 CAS). Saskatoon, 70-09-19, E.J. Kiteley (4 EJK). Christopher Lake, 46-07-30, E.J. Kiteley (1 EJK). Great Deer, 49-04-25, J.R. Vockeroth (4 CNC). Elbow, 60-06-03, A.R. Brooks (1 CNC). Cochin, 59-05-20, A.R. Brooks (1 CNC).

United States: California: Modoc Co.: Menlo Baths, 4 mi. SE of Eagleville, 4550', 66-08-28, H.B. Leech (1 CAS). Mono Co.: Mammoth, 45-09-15, G.P. Mackenzie (5 CAS). Siskiyou Co.: Indian Tom Lake, 67-05-08, J. Schuh (86 JS). Indian Tom Lake, 65-09-15, J. Schuh (43 JS). Indian Tom Lake, 66-09-27, J. Schuh (12 JS). Willow Cr., 55-07-14, J. Schuh (1 JS). Tulare Co.: Beach Ridge, 9200', 65-07-30, D.R. Schuh (2 JS). Colorado: Alamosa Co.: 9 mi. E. of Hooper, 1 mi. W. of Dollar Lake, drainage ditch, 65-08-13, H.B. Leech (14 CAS). Alamosa, no date, F.C. Bowditch (1 MCZ). Costilla Co.: Garland, no date, Hubbard & Schwarz (1 CAS). Garland, no date, no collr. (2 ASP). Garland, no date, F.C. Bowditch (1 MCZ). Grand Co.: Gore Pass, 49-08-15, O. Bryant (2 CAS). Larimer Co.: No. Park, 8000', 33-08-18, E.B. Andrews (1 CAS). R. Mt. Natl. Park, 7900', 33-10-08, E.B. Andrews (1 CAS). Rocky Mtn. N.P., 33-07-28, G. & J. Sperry (1 CAS). Estespark, R. Mt. Nat'l. Park, 7900', 33-08-10, E.B. Andrews (1 CU). R. Mt. Nat'l. Park, Beaver Lk. 33-07-28, G. & J. Sperry (2 MCZ). Park Co.: 1.5 m. E. of Hartsel, weedy pool, 65-08-15, H.B. Leech (1 CAS). Saguache Co.: Mineral Hot Springs, ca 7700', 65-08-13, H.B. Leech (31 CAS). Saguache, 52-08-18, B. Malkin & Vet (7 CFMNH). Idaho: Bannock Co.: Pocatello, no date, no collr. (1 USNM). Bingham Co.: No site, no date, Hubbard & Schwarz (1 USNM). Montana: Blaine Co.: Bear Paw Mt., no date, Hubbard & Schwarz (1 USNM). Nevada: Elko Co.: 9 mi. NE Montello, Thousands Springs Cr., route 30, 69-08-26, H.B. Leech (5 CAS). Lincoln Co.: Upper Pahranagat Lake, 71-08-05, P.D. Perkins (12 PDP). North Dakota: Bottineau Co.: No site, 63-05-23, R. Gordon (1 CAS; 1 USNM). Lake Metigoshe, 63-05-23, R. Gordon (32 USNM). Burke Co.: No site, 66-05-23, R. Gordon (4 CAS). No site, 63-06-23, R. Gordon (2 USNM). Dunn Co.: Killdeer Mts., 63-05-22, R. Gordon (1 RG). Foster Co.: No site. 63-05-01, R. Gordon (2 USNM; 1 CAS). Grant Co.: Lake Tschida, 66-05-21, R. Gordon (1 USNM; 1 CAS). Griggs Co.: Binford, 66-06-02, R. Gordon (5 USNM). Mchenry Co.: No site, 62-09-11, R. Gordon & R. Post (3 USNM). Nelson Co.: No site, 63-06-20, R. Gordon (2 USNM). Pierce Co.: No site, 63-05-14, R. Gordon (3 USNM). Ramsey Co.: Devils Lake, 17-07-23, R.T. Young (19 USNM). Renville Co.: Sherwood, 13 mi. west, 66-05-29, R. Gordon (1 USNM). Rolette Co.: Dunseith, jct. Hwy. 3 & 43, 0.5 mi. W. 70-06-06, R. Gordon (3 RG). Slope Co.: Burn

Coal Vein, 65-06-07, L. Grochowski (1 USNM). Chalky Buttes, 65-06-07, W. Kotchman (1 USNM). Oregon: Douglas Co.: Roseburg, 59-04-24, H. Foster (1 ODA). Harney Co.: Malheur Lake, 51-06-21, B. Malkin (119 UWA; 28 CFMNH). Steens Mts., Fish Lake, 7500', 51-06-26, B. Malkin (3 UWA). Hot Spgs., SE shore of Harney Lake 51-06-20, B. Malkin (9 UWA; 1 CFMNH). Fish Lake, Steens Mts., 58-08-16, J.H. Baker (1 JS). Steens Mts., Fish Lake, 7500', 51-06-22, B. Malkin (3 CFMNH). Jackson Co.: Ashland, at light, 52-07-08, Black & Davis (1 ODA). Klamath Co.: Barkley Springs, 59-09-08, J. Schuh (3 JS; 3 UW). Dairy, 38-06-15, M.H. Hatch (4 UWA). Klamath Falls, 50-09-03, B. Malkin (2 UWA). Klamath Falls, light trap, 60-06-08, J.D. Vertrees (1 UWA). Lower Klamath Lake, 55-07-03, J. Schuh (3 UWA). Klamath Falls, Barkley Springs, 55-06-01, J. Schuh (1 UWA). Poe Valley, temporary pond, 66-06-05, J. Schuh (4 JS). Lower Klamath Lake, roadside ditch, 66-06-06, J. Schuh (18 JS). Klamath Falls, above Geary Ranch, Sweeping swamp, 61-05-17, J. Schuh (1 JS). Lower Klamath Lake, in alkaline lake, 58-05-30, J. Schuh (1 JS). Klamath Falls, Poe Valley, in pond, 55-05-27, J. Schuh (1 JS). Near Gerber Dam, 57-06-16, J. Schuh (1 JS). Upper Klamath Lake, Geary Canal, 57-04-22, J. Schuh (1 JS). Klamath Falls, Algoma, mech. trap, 55-07-13, J. Schuh (1 JS). Upper Klamath Lake, along shore line, 55-04-24, J. Schuh (1 JS). Klamath Falls, lite, 67-05-15, J. Schuh (3 JS). Lake Co.: Abert lake, 57-04-28, J. Schuh (1. JS). Malheur Co.: Sheepshead Mts., 51-06-18, B. Malkin (7 UWA). South Dakota: Beadle Co.: Wolsey, 3 mi. NW, 40-06-20, G. Spawn (1 SDSU). Brookings Co.: Brookings, light trap, 56-07-18, H. Severin (2 SDSU). Brown Co.: Groton, 17 mi. N., 40-06-20, H. Severin (2 SDSU). Houghton, 8 mi. W., 41-06-14, H. Severin (1 SDSU). Day Co.: Waubay Refuge, alkali water, 40-06-22, H. Severin (19 SDSU). Andover, 2 mi. E., 40-06-26, G. Spawn (1 SDSU). Roslyn, 39-09-14, H. Severin (2 SDSU). McPherson Co.: Eureka, 40-06-25, H. Severin (2 SDSU). Utah: Millard Co.: Shore of Pruess Lake, 64-08-04, H.B. Leech (14 CAS). Rich Co.: Randolph, 55-07-14, S.L. Wood (1 CNC). Washington: Pend Oreille Co.: Diamond L., 7 mi. NE Camden, 34-08-13, M.H. Hatch (1 UWA). Spokane Co.: Deer Park, 32-08-25, M.H. Hatch (1 UWA). Wyoming: Albany Co.: Laramie, 94-03-13, Hubbard & Schwarz (6 USNM). Rock Creek, 5000', 41-08-24, H.P. Chandler (1 CAS). Johnson Co.: S. Fork of Crazy Woman Cr., 64-07-27, H.B. Leech (1 CAS). Sweetwater Co.: 10 mi. W. Rock Springs, Ox-bow cut-off of Bitter Cr., 65-08-23, H.B. Leech (1 CAS). Yellowstone National Park: Natl. Park, no date, Hubbard & Schwarz (1 USNM). Yellowstone Natl. Park, canyon, 37-09-01, M.H. Hatch (14 UWA).

8. *Ochthebius uniformis* new species

Map: Figure 117C

Paratypes: 80

United States: California: Del Norte Co.: 2 mi. S. Crescent city, roadside pond, 67-03-29, Schuh & Vertrees (23 JS). Humboldt Co.: Arcata, no date, Van Dyke (1 CAS). Marin Co.: Dipsea, no date, F.E. Blaisdell (1 CAS). Dillon Beach, pools, foot of Sand Point Dunes, 63-06-24, H.B. Leech (1 CAS). Pt. Reyes Penin., no date, D. Giuliani (2 CAS). Whale Beach, 8 mi. W. Inverness, 62-08-18, J. Doyen (1 UBC). San Francisco Co.: San Francisco, 09-09-09, F.E. Blaisdell (4 CAS). San Francisco, 09-03-28, F.E. Blaisdell (7 CAS). San Francisco, 16-09-16, Van Dyke (10 CAS). San Francisco, no date, E.S. Ross (1 CAS). San Luis Obispo Co.: Lopez Canyon Dam outlet, 70-09-05, P.D. Perkins (1 PDP). Sonoma Co.: 2.8 mi. S. & E. Bodega Bay, 63-07-01, H.B. Leech (1 CAS). Oregon: Harney Co.: Steens Mts., Fish Lake, 7500', 51-06-22, B. Malkin (8 CFMNH). Lane Co.: 7 mi. S. Florence, pond near beach, 62-05-01, Vertrees, Hansen, Carter & Schuh (10 JS). 7 mi. S. Florence, Siltcoos Beach, 62-05-01, Vertress, Hansen, Carter & Schuh (8 JS). Washington: Pacific Co.: Seaview, 32-07-25, no collr. (1 UWA).

9. *Ochthebius borealis* new species

Map: Figure 117C

Paratypes: 362

Canada: British Columbia: Fernie, 34-07-26, H.B. Leech (6 CAS). Hosmer, Hosmer Cr., 49-07-08, H.B. Leech (2 CAS). Nation River Dist., 40-06-25, G.B. Leech (2 CAS). Skunk Lake, Manson R. Dist., 40-07-22, G.B. Leech (1 CAS). McNair L., 5.5 mi. W. Skookumchuck, E. Kootenays, 56-07-17, H.B. Leech (1 CAS).

Mexico: Baja California: Sierra San Pedro Martir, La Grulla, 6900', 53-06-12, P.H. Arnaud, Jr. (12 CAS).

United States: California: Fresno Co.: Kaiser Peak Meadow N. of Huntington L., 8420', 71-08-25, H.B. Leech (1 CAS). Glenn Co.: NW corner of Glenn co., 4.5 mi. S. of Mendocino Pass, pool in stream, grassy slope, 6500', 60-07-29, H.B. Leech (17 CAS). Plaskett Mdws., stream from N. entering lower Plaskett Lake, 6000', 60-07-28, H.B. Leech (7 CAS). Lassen Co.: Martins Spgs., 22-08-08, J.O. Martin (12 CAS). Madera Co.: Nidiver Lakes, 10,000', 51-07-05, P.H. Raven (1 CAS). Modoc Co.: 3 mi. S. Lake City, Soldier Cr., 66-08-25, H.B. Leech (1 CAS). Mono Co.: Round pond on ridge south of Leavitt Mdw., 7500', 63-08-13, H.B. Leech (5 CAS). Pond on ridge S. of Leavitt Meadow, 7500', 62-08-10, H.B. Leech (13 CAS). Poore Lake, 7514', 63-08-14, H.B. Leech (1 CAS). Napa Co.: Burton Cr., Pope Valley, 64-05-10, H.B. Leech (1 CAS). Nevada Co.: Truckee, 5800', no date, Wickham (3 USNM; 4 MCZ). Webber Lake to Meadow Lake, 64-08-22, E. Ball, Jr., (1 JS). Sagehen Cr. nr. Hobart Mills, 66-06-26, W.J. Turner (7 UCB). Placer Co.: Lake Tahoe, 19-08-15, J.O. Martin (14 CAS). Lake Tahoe, no date, A. Koebele (1 CAS). No site, no date,

A. Koebele (1 USNM). Riverside Co.: Riverside, no date, F.E. Winters (1 CAS). S. Cal., no date, no collr. (1 USNM). San Bernardino Co.: San Bernardino Mts., no date, F.E. Winters (1 CAS). Bear Lake, 17-07-02, J.O. Martin (10 CAS, 1 CU). Santa Clara Co.: Stanford Univ., 53-12-22, P.S. Bartholomew (9 CAS). Sierra Co.: Onion Cr., N. end Onion Valley, 6075', 64-10-21, H.B. Leech (1 CAS). Siskiyou Co.: Head of W. Branch Indian Cr., at Poker Flat, 5040', 66-08-14, H.B. Leech (2 CAS). S. Fk. Sacramento River, 5200', 53-07-08, H.P. Chandler (1 CAS). Headwaters E. Fork of S. Fork Salmon River, Cecillville-Callahan road, 6000', 68-07-31, H.B. Leech (10 CAS). Lower Boulder Lake, Scott Mts., S. of Callahan, 6280', 70-08-25, H.B. Leech (10 CAS). Upper Boulder Lake, Scott Mts. S. of Callahan, 6780', 70-08-25, H.B. Leech (4 CAS). East Boulder Lake, Scott Mts. S. of Callahan, 6680', 70-08-25, H.B. Leech (36 CAS). Blanche Lake, 4 mi. by road SE of Medicine Lake, ca. 6725', 66-08-24, H.B. Leech (1 CAS). Medicine Lake, sweep edge lagoon, 64-06-30, J. Schuh (1 JS). Stream flowing into Meeks Meadow Lake, 6.25 mi. airline SW Etna, 1925 m., 72-08-23, H.B. Leech (1 CAS). Tehama Co.: SW corner Tehama Co., 2 mi. SW of Government Camp, pool in bed of dried up stream, grassy slope, 6000', 60-07-29, H.B. Leech (30 CAS). Tulare Co.: Monache Mdws., 58-08-10, D. Giuliani (2 CAS). Rt. 180 east of Gen. Grant Pk., 55-06-26, P.S. Bartholomew (1 CAS). Tuolumne Co.: Sonora Pass, trib. Deadman Cr., 9500', 62-08-09, H.B. Leech (6 CAS). Niagara Cr., Forest Campgrd., 6600', 62-08-09, H.B. Leech (1 CAS). Trinity Co.: Carrville, 47-08-21, no collr., (2 CAS). Unspecified Co.: No site, no date, no collr. (4 ASP; 2 MCZ). Colorado: Larimer Co.: North Park, 8000', 33-08-18, E.B. Andrews (2 CAS). Summit Co.: Fremont Pass, 300', 52-08-17, B. Malkin (4 CFMNH). Idaho: Bingham Co.: No site, no date, Hubbard & Schwarz (6 USNM). Blaine Co.: Galena, 52-07-22, B. Malkin (1 UWA). Bonner Co.: Pack River, 50-07-19, H.B. Leech (1 CAS). Elmore Co.: Alturas Lake, Sawtooth Mts., 52-07-22, B. Malkin (18 CFMNH; 20 UWA). Kootenai Co.: Athol, 53-05-12, W.F. Barr (1 UI; 1 UWA). Nevada: Lincoln Co.: Mormon, no date, Hubbard & Schwarz (1 CAS). Unspecified Co.: No site, no date, no collr. (5 ASP). Oregon: Curry Co.: Pistol River, 52-06-18, B. Malkin (1 UWA). Harney Co.: Steens Mts., Fish Lake, 7580', 51-06-22, B. Malkin (13 UWA). Lane Co.: McKenzie Pass, 30-06-21, M.H. Hatch (1 UWA). Washington: Pacific Co.: Tokeland, 29-07-10, no collr. (2 UWA). Wyoming: Fremont Co.: 50 mi. SW Lander on Hiway 287, marg. veg., 51-05-17, G.K. Todd (31 INHS). Sheridan Co.: 5 mi. NE of Granite Pass, roadside pool draining into Owen Cr., Big Horn Mts., 64-07-25, H.B. Leech (1 CAS). Uinta Co.: Trib. to Muddy Cr. at Hwy. 80, 8.3 mi. W. of Fort Bridger, 65-08-23, F.O. Leech (1 CAS).

10. *Ochthebius kaszabi* Janssens

Map: Figure 92A

Specimens examined: 286

Canada: Alberta: Edmonton, 19-04-26, F.S. Carr (1 CAS). Edmonton, 19-08-28, F.S. Carr (1 CAS). Edmonton, 17-09-15, F.S. Carr (2 CAS). Edmonton, 24-05-02, O. Bryant (1 CAS). 6 mi. S. Pincher Creek, 71-08-01, P.D. Perkins (18 PDP). Cypress Hills Prov. Pk., 62-06-17, C.W. O'Brien (1 MCZ). Edmonton, 22-08-07, no collr. (4 OSU). Castor, no date, no collr. (1 OSU). Bittern Lake, 61-08-15, A. & M. Brooks (3 CNC). British Columbia: Vernon, 37-09-18, H.B. Leech (1 CAS). Vernon, 40-09-02, H.B. Leech (1 CAS). Armstrong, 45-06-01, H.B. Leech (2 CAS). Salmon Arm, 29-08-26, H.B. Leech (2 CAS). Salmon Arm, 29-08-30, H.B. Leech (1 CAS). Salmon Arm, 37-09-06, H.B. Leech (1 CAS). Salmon Arm, 39-07-02, H.B. Leech (7 CAS). Falkland, 32-09-16, E.B. Andrews (1 CAS). Lillooet Dist., 11 mi. S. Clinton, 71-07-23, P.D. Perkins (3 PDP). Kamloops, no date, Wickham (2 USNM). Cranbrook, 56-08-12, G. Stace Smith (6 UBC). Copper Mtn., Similkameen River, 30-09-04, G. Stace Smith (13 UBC; 5 CNC). Copper Mtn., Similkameen River, 30-08-24, G. Stace Smith (6 UBC). Manitoba: The Pas, 30-05-28, O. Bryant (5 CAS). Treesbank, 4 mi. W. Hwy. 344, 68-08-14, R. Gordon (9 USNM). Winnipeg, 16-09-02, J.B. Wallis (1 CNC). Winnipeg, no date, J.B. Wallis (1 CU). Winnipeg Beach, 10-07-11, J.B. Wallis (1 MCZ). Churchill, 37-08-10, W.J. Brown (17 CNC). Treesbank, 10-07-25, J.B. Wallis (4 CNC). Winnipeg Beach, 10-08-23, J.B. Wallis (1 CNC). Aweme, 10-07-20, J.B. Wallis (1 CNC). New Brunswick: French lake, 28-07-06, W.J. Brown (1 CNC). Northwest Territories: Ft. Simpson, 72-06-14, A. Smetana (34 CNC). Spence River, 38 mi. SE Ft. Simpson, 72-06-19, A. Smetana (1 CNC). Harris River, Ft. Simpson, 72-06-15, A. Smetana (13 CNC). Rabbitskin R., 23 mi. SE Ft. Simpson, 72-06-12, A. Smetana (12 CNC). Ontario: Mer Bleue, 27-05-28, W.J. Brown (1 CNC). Ottawa, 30-05-15, W.J. Brown (4 CNC). Arnprior, 36-07-07, W.J. Brown (1 CNC). Quebec: Quarry Is., Mingan, 29-06-13, W.J. Brown (1 CAS;6 CNC). Pettit, no date, Hubbard & Schwarz (3 USNM). Wakefield, 30-06-04, W.J. Brown (17 CNC). Pettit, no date, no collr. (1 MCZ). Montreal, 69-06-25, E.J. Kiteley (1 EJK). Montreal, 69-08-05, E.J. Kiteley (1 EJK). Montreal, 69-09-07, E.J. Kiteley (1 EJK). Fairy Lake, 30-05-13, W.J. Brown (1 CNC). Saskatchewan: Yorkton, 47-07-27, C.C. Shaw (2 CAS). Carlton, 48-09-11, J.R. Vockeroth (1 CNC).

United States: Alaska: Fairbanks, Farmers Loop, 57-08-11, E.L. Kessel (5 CAS). 100 mi. N. of Ft. Yukon, 27-05-12, J.M. Jessup (1 USNM). Ft. Yukon, no date, J.M. Jessup (19 UWA). Massachusetts: Barnstaple Co.: Nonamasset Isd., 59-07-05, F.N. Young (7 PDP). Minnesota: Stearns Co.: St. Cloud, 10-01-66, no collr. (5 SC). St. Cloud, 67-09-25, no collr. (4 SC). St. Cloud, 66-04-20, no collr. (1 SC). North Dakota: Bottineau Co.: No site, 62-07-15, R. Gordon (1 USNM). Lake Metigoshe, 63-05-23, R. Gordon (3 USNM). Cass Co.: Fargo, 66-07-07, R. Gordon (1 RG). Divide Co.: No site, 63-05-23, R. Gordon (1 USNM). Nelson Co.: No site, 63-05-03, R. Gordon (1 USNM). Pierce Co.: No site, 63-05-14, R. Gordon (1 USNM). Richland Co.: No site, 64-08-19, R. Gordon (2 USNM).

T.135N R.52W, Sec.5, NW1/4, 68-08-22, no collr. (5 USNM). Mirror Pool, 65-08-20, R. Gordon (1 RG). Rolette Co.: Dunseith, nr. jct. Hwy. 3 & 43, 68-08-18, R. Gordon (1 USNM; 5 RG). Sargent Co.: Tewaukon Ref. Headq. spring, 68-08-23, R. Gorgon (7 USNM).

11. *Ochthebius rectus* LeConte

Map: Figure 101D

Specimens examined: 453

Canada: British Columbia: Royal Oak, V.I., 55-06-09, E. Argyle (1 UBC).

United States: Arizona: Cochise Co.: Huachuca Mts., Huachuca Canyon, 72-05-02, A.R. Gillogly (1 PDP). California: Alameda Co.: No site, no date, A. Koebele (4 CAS). Contra Costa Co.: Berkeley, no date, F. Winters (1 CU; 4 CAS). Millbrae, 12-08-21, no collr. (1 CAS). No site, 38-05-01, F. Blum (1 OSU). Humboldt Co.: Arcata, no date, no collr. (1 CAS). Inyo Co.: Deep Springs, Deep Springs Valley, ca. 19 air mi. E. Bishop, 71-03-01, D. Giuliani (2 CAS). As above, 71-01-01 (2 CAS). As above, 71-02-01 (1 CAS). Saline Valley, Palm Spring, at edge of hot spring, 71-05-04, D. Giuliani (1 CAS). Deep Springs Valley, Buckhorn Springs, 72-01-22, D. Giuliani (2 CAS). As above, 71-04-22 (6 CAS). Saline Valley, Salt Lake, 71-09-21, D. Giuliani (4 CAS). Saline Valley, in small waterhole on alkaline flat, 71-05-04, D. Giuliani (7 CAS). Little Black Rock Spring, 71-05-28, D. Giuliani (7 CAS). Lone Pine, 37-05-26, C.D. Michener (4 CNC; 1 CU; 26 CAS). Slough near Deep Springs Lk., 4700', 54-06-19, P. Raven (6 CAS). Owens Lake, 72-03-01, D. Giuliani (6 CAS). Bad Water, Death Valley, 38-04-14, J. duBois (6 CAS). Cow Creek, Death Valley, 64-06-04, E. Hilbert (56 CAS). Grimshaw Lake, freshwater, Tecopa, 1320', 67-03-22, H.B. Leech (2 CAS). Pools, stream W. of Harmony Borax Works, Death Valley, -250', 67-03-21, H.B. Leech (4 CAS). Furnace Creek Ranch, 15 mi. N., Death Valley, 31-06-08, J. Slevin (2 CAS). Death Valley, Salt Creek, 63-12-27, R. Bandar (2 CAS). Panamint Valley, 91-04-01, A. Koebele (3 USNM). Shoshone, no date, no collr. (3 CAS). Death Valley, Badwater, 55-03-15, J. Schuh (1 JS). Bridgeport, 6465', 33-07-15, Wickham (2 MCZ). Owens River, 7 mi. NW Bishop, 4400', 70-11-30, P.D. Perkins (1 PDP). Kern Co.: Lebec, 45-06-28, G.P. Mackenzie (1 CAS). Los Angeles Co.: Los Angeles, no date, F. Winters (2 CAS). Los Angeles, no date, Coquillett (2 USNM). Pomona, no date, W. Richardson (3 USNM). Redondo, no date, no collr. (2 CAS). Modoc Co.: Hot Springs, 5 mi. E. Cedarville, 60-06-05, J. Schuh (1 JS). Mono Co.: Travertine Hot Sprgs., 2 mi. SE Bridgeport, 6700'. 62-08-11, H.B. Leech (1 CAS). Bridgeport, 6465', no date, Wickham (11 USNM). 6 mi. N. Bishop, Fish Slough, 70-04-20, P.D. Perkins (1 PDP). Orange Co.: Seal Beach, salt marsh, 71-09-22, I. Moore (10 UCR). Riverside Co.: Palm Springs, no date, F. Winters (1 CAS). Riverside, no date, F. Winters (13 CAS). Riverside, no date, no collr. (2 USNM). Riverside, no date, H.C. Fall (11 MCZ). Fish Springs, Salton Sea, 45-12-12, H. P. Chandler (1 CAS). Salton Sea, 16-04-16, J.O. Martin (1 CAS). Salton, no date, Hubbard & Schwarz (5 USNM). San Jacinto Mts., no date, F.W. Winters (1 OSU). Sonorian Region, no date, F.E. Winters (1 CU). San Benito Co.: Griswold Creek, Lyons Canyon on road to Idria, 63-07-21, H.B. Leech (9 CAS). San Bernardino Co.: Death Valley NM. Saratoga Spring, 70-10-12, P.D. Perkins (6 PDP). San Diego Co.: Mountain Palm Spr., Anza Desert, 65-04-14, no collr. (1 CAS). San Mateo Co.: SF Bay marsh E. Palo Alto, 63-01-01, P.S. Bartholomew (4 CAS). Santa Barbara Co.: Santa Barbara, no date, F. Winters (9 CAS). Santa Clara Co.: Los Gatos, no date, Hubbard & Schwarz (1 USNM). Unspecified Co.: No site, no date, no collr. (5 CFMNH; 2 ASP; 4 MCZ). Idaho: Bear Lake Co.: N. shore of Bear Lake, 52-07-06, B. Malkin (1 UWA). Nevada: Elko Co.: Thousand Springs creek, Route 30, 9 mi NE Montello, 69-08-26, H.B. Leech (12 CAS). Nye Co.: Ash Meadows, in swim pool, 66-03-30, J. Schuh (4 JS). 2 mi. N. Beatty, saline pool, 66-03-29, J. Schuh (1 JS). Washoe Co.: 8 mi. S. Reno, alkaline irrigation ditch, 74-04-28, A.R. Gillogly (37 PDP). Oregon: Harney Co.: Hot Springs, SE shore of Harney Lake, 51-06-20, B. Malkin (19 CFMNH; 22 UWA). Malheur Lake, 51-06-20, B. Malkin (1 UWA). 1/2 mi. S. of Harney Lake, muck, hot spring temp. 90 degrees F., 61-10-23, K. Goeden (1 UWA). 1/2 mi. S. Harney Lake, hot spring temp. 100 degrees F., 62-08-09, K. Goeden (11 ODA). Trout Creek Hot Springs, 62-09-29, K. Goeden (6 ODA). Mickey Hot Spring, 62-09-26, K. Goeden (3 ODA). 9 mi. N. Andrews, margins of hot springs, 62-09-26, K. Goeden (3 ODA). Borax Hot Lake, 62-09-27, K. Goeden (18 ODA). 20 mi. W. Malheur Lake, hot springs, 56-05-18, K. Goeden (13 ODA). 1/2 mi. S. Harney Lake, hot spring, 63-06-04, K. Goeden (2 ODA). Klamath Co.: Bly, 45-06-13, K.M. Fender (1 UWA). Upper Klamath Lake, along shoreline, 55-04-24, J. Schuh (1 JS). Mare's Egg Spring, 59-09-07, J. Schuh (1 JS). Lake Co.: Fresh pool, SE shore Lake Albert, 50-07-17, H.B. Leech (1 CAS). Malheur Co : 15 mi. NW Vale, hot springs, temp, 108 degrees F., 62-09-09, K. Goeden (1 ODA). Utah: Unspecified Co.: Clear Lake, 33-07-02, Wickham (1 USNM). Washington: Pacific Co.: Nasel River, salt marsh, 30-08-06, no collr. (4 UWA). Bay Center, 31-03-26, no collr. (4 UWA). Nahcotta, 55-08-18, no collr. (1 UWA). Tokeland, 29-07-10, no collr. (1 UWA). San Juan Co.: Lopez Is., 26-07-03, no collr. (1 UWA). Wyoming: Albany Co.: Laramie, 94-03-13, no collr. (1 USNM). Unspecified Co.: No site, no date, no collr. (1 ASP).

12. *Ochthebius rectusalsus* new species

Map: Figure 101E

Paratypes: 52

Mexico: Baja California: Norte, 3.2 mi. S. Colonia Guerrero, 63-04-24, H.B. Leech (1 CAS). La Salina, 4 mi. S. La Mision de San Miguel, 61-05-21, I. Moore (1 CNC). Norte, Mision de San Miguel, on mud, salt flat, 59-06-21, I. Moore (1 CAS).

United States: California: Contra Costa Co.: Same data as Holotype (16 CAS: 3 USNM; 2 PDP; 2 UI). Los Angeles Co.: Naples, 19-04-06, J.O. Martin (8 CAS). Pasadena, no date, no collr. (1 CAS). Redondo, no date, no collr. (1 CAS). S. Cal., no date, no collr. (1 USNM). Marin Co.: Inverness, in salt marsh, 10-08-14, no collr. (1 CAS). Merced Co.: Los Banos, 18-05-23, E.P. VanDuzee (1 CAS). Monterey Co.: Moss Landing, 09-01-22, no collr. (1 CAS). San Diego Co.: San Diego, 92-02-24, Fall (3 MCZ). No site, no date, F.E. Blaisdell (1 CAS). San Mateo Co.: Millbrae, in salt ponds, 12-07-21, no collr. (2 CAS). Santa Barbara Co.: Santa Barbara, no date, F. Winters (1 OSU). Ventura Co.: Ojai Valley, no date, Hubbard & Schwarz (2 USNM). Washington: Clallam Co.: Sequim, 28-07-21, no collr. (1 UWA).

13. *Ochthebius recticulus* new species

Map: Figure 101E

Paratypes: 143

United States: California: Colusa Co.: Same data as Holotype (20 USNM; 10 MCZ; 10 CNC; 60 PDP). Wilbur Hot Springs, 74-06-26, W.N. Mathis (11 USNM; 6 ORSU). Tributary to Bear Creek, 9 mi. N. Wilbur Hot Springs, no date, H.B. Leech (1 CAS). Sulphur Cr. at Wilbur Hot Sprs., 60-07-14, H.B. Leech (25 CAS).

14. *Ochthebius bisinuatus* new species

Map: Figure 101F

Paratypes: 478

Canada: Alberta: Waterton River at Rt. 2, 15 mi. S. Macleod, 69-08-20, H.B. Leech (4 CAS). British Columbia: Fernie, 35-08-12, H.B. Leech (2 CAS). Lillooet Dist., 11 mi. S. Clinton, 71-07-23, P.D. Perkins (36 PDP). Cariboo Dist., 40 mi. NE McLeese Lake, 71-07-28, P.D. Perkins (15 PDP). Creston, Goat River, 45-09-23, G. Stace Smith (3 UBC). As above, 45-09-30 (1 UBC). As above, 46-08-25 (1 UBC). As above, 47-08-31 (1 UBC). Summerland, 32-05-28, A.N. Gartrell (1 CNC).

United States: California: Del Norte Co.: Smith River, 35-07-15, no collr. (1 UWA). Colusa Co.: Little Stony Cr., 6 mi. S. Stonyford, 56-03-29, H.B. Leech (5 CAS). Glenn Co.: N. fork Stony Cr., 0.5 mi. W. of Newville, 66-04-04, H.B. Leech (1 CAS). Humboldt Co.: North Dobbyn Cr., Alderpoint-Blocksburg Rd., 68-07-19. H.B. Leech (1 CAS). No site, 11-05-03, Nunenmacher (1 CFMNH). South Eel River at Weott, 155', 70-08-30, H.B. Leech (2 CAS). Lake Co.: Middle Cr., Upper Lake, 49-05-28, H.B. Leech (11 CAS). Mendocino Co.: Black Butte River just above mouth, 68-07-17, H.B. Leech (1 CAS). Middle fork of Eel River, 0.3 mi. below mouth of Black Butte River, 1500', 68-07-16, H.B. Leech (10 CAS). Plumas Co.: Clio, on middle fork Feather River, 61-08-28, H.B. Leech (8 CAS). Mohawk, 57-07-09, D.C. Rentz (4 CAS). San Joaquin Co.: Manteca, 52-08-24, P.S. Bartholomew (2 CAS). Shasta Co.: Hat Cr., 3000', 47-06-28, H.P. Chandler (1 CAS). Sierra Co.: Onion Cr., N. end Onion Valley 6075', 64-10-21, H.B. Leech (1 CAS). Siskiyou Co.: North fork Salmon River, 5 mi. NE of Forks of Salmon, 68-07-26, H.B. Leech (10 CAS). Scott River, 1.5 mi. SE of Kelsey Cr., 66-08-17, H.B. Leech (1 CAS). Sonoma Co.: Cloverdale, 26-06-19, V.S. Brown (2 CAS). Tehama Co.: Red Bluff, 22-05-01, V.S. Brown (1 CAS). Trinity Co.: Mad River, 6 mi. S. Ruth, 60-07-31, H.B. Leech (5 CAS). Trinity River at Big Flat, 60-08-04, H.B. Leech (14 CAS). Hayfork Cr., 0.5 mi. E. of Hyampon, 68-07-23, H.B. Leech (2 CAS). Mad River just above mouth Van Horn Cr., 4.25 air mi. SE of Ruth, pools in drying bed of upper Mad River, 70-08-07, H.B. Leech (6 CAS). Idaho: Custer Co.: Salmon R., 14 mi. N. Challis, 71-08-03, P.D. Perkins (3 PDP). Latah Co.: Boville, 32-06-18, M.H. Hatch (2 UWA). Lemhi Co.: Salmon R., 4 mi. N. Salmon, 71-08-03, P.D. Perkins (12 PDP). Twin Falls Co.: 11 mi. E. Rogerson, 52-07-20, B. Malkin (2 UWA). Magic Hot Springs, 52-07-20, B. Malkin (22 UWA; 21 CFMNH). Montana: Blaine Co.: Bear Paw Mt., no date, Hubbard and Schwarz (2 USNM). Ravalli Co.: Mill Cr. at Hwy. 93, 7 mi. N. Hamilton, 71-08-02, P.D. Perkins (23 PDP). Oregon: Benton Co.: Monroe, 30-06-18, M.H. Hatch (1 UWA). Corvallis, pond, 56-04-08, K. Goeden (1 ODA). Harney Co.: Blitzen River, 2 mi. E. Frenchglen, 4400', 64-07-15, T. Schuh and J.D. Lattin (4 CAS; 6 JS; 9 ORSU). Klamath CO.: Sprague River, 12 mi. E. Chiloquin, 51-07-03, B. Malkin (3 UWA). Sprague River, 12 mi. E. Chiloquin, 51-06-01, B. Malkin (2 CFMNH). Sprague River nr. Bly, 52-06-22, B. Malkin (1 CFMNH). Lake Co.: Chandler State Park, 51-06-30, B. Malkin (3 UMA; 3 CFMNH). Linn Co.: Albany, 33-07-23, Wickham (1 USNM). Malheur Co.: Sucker Creek Canyon, 51-06-18, B. Malkin (2 UWA; 4 CDMNH). Umatilla Co.: Echo, 32-08-31, M.H. Hatch (1 UWA). Yamhill Co.: McMinnville, 42-07-05, K.M. Fender (4 UWA). Unspecified Co.: Medicine Lake, 36-07-04, no collr. (1 UWA). Washington: Benton Co.: Plymouth, 32-09-01, M.H. Hatch (1 UWA). Chelan Co.: Wenatchee, 32-08-23, M.H. Hatch (6 UWA). Entiat, 32-08-23, M.H. Hatch (4 UWA). Clallam Co.: Pysht River, 32-05-30, no collr. (1 UWA). Cowlitz Co.: Castle Rock, 32-07-10, no collr. (1 UWA). Jefferson Co.: Bogachiel River, 32-05-30, no collr. (1 UWA).

King Co.: N. Bend, 31-05-20, V. Tartar (3 UWA). Green River Gorge, 31-05-20, M.H. Hatch (2 UWA). Green River Gorge, 56-07-15, Malkin and Kottke (4 CFMNH). Evans Creek, 29-07-04, M.H. Hatch (1 UWA). North Bend, Maloney's Grove, 46-05-23, M.H. Hatch (5 UWA). As above, 30-06-29, M.H. Hatch (12 UWA). As above, 30-05-10, M.H. Hatch (38 UWA). Snoqualmie River, Maloney's Grove, 27-09-05, M.H. Hatch (16 UWA). Renton, 13-05-31, no collr. (22 UWA). Snoqualmie Falls, 30-05-10, M.H. Hatch (2 UWA). Kittitas Co.: Yakima River Canyon, 30-09-17, M.H. Hatch (4 UWA). Ellensberg, 32-07-19, M.H. Hatch (10 UWA). Pacific Co.: Willapa River, 30-09-09, no collr. (1 UWA). Snohomish Co.: Arlington, 27-08-21, M.H. Hatch (4 UWA). Sultan, 30-05-02, M.H. Hatch (5 UWA). Sultan, 53-06-01, Malkin and Boddy (7 CFMNH). Stilaguamish River, 28-07-15, no collr. (6 UWA). N.F. Stilaguamish River, Cicero, 27-08-21, M.H. Hatch (24 UWA). Spokane Co.: Spokane, no date, Wickham (1 USNM). Spokane, 32-08-26, M.H. Hatch (3 UWA). Unspecified Co.: Iron Creek, 35-08-28, no collr. (2 UWA). S.F. Skokomish River, 56-07-15, Malkin and Kottke (4 CFMNH). Neilson Lake, 30-05-23, M.H. Hatch (1 UWA). Wyoming: Natrona Co.: Badwater Cr. at Badwater, NW of Arminto, 65-08-21, H.B. Leech (1 CAS).

15. *Ochthebius californicus* new species

Map: Figure 117B

Paratypes: 116

United States: California: Alameda Co.: Arroyo d. Valle, 72-03-06 W.H. Tyson (1 RG). Butte Co.: Little Chico Creek, 70-11-26, P.D. Perkins (4 PDP). Fresno Co.: Fresno, no date, E.A. Schwarz (1 USNM). Inyo Co.: Tinemaha Reservoir, 71-15-13, D. Giuliani (9 CAS). Lone Pine, 3500', 13-06-15, R. Hopping (4 CAS). Lassen Co.: Eagle Lake, 21-07-31, J.O. Martin (10 CAS). Los Angeles Co.: Little Rock, Mojave Desert, no date, F.E. Winters (3 CAS). Tejon Pass, 18-07-28, J.O. Martin (1 CAS). Pasadena, no date, no collr. (1 CAS). San Gabriel River, Rincon Sta., 1800', 71-04-17, P.D. Perkins (2 PDP). San Gabriel River, 4 mi. N. Azuza, 71-04-17, P.D. Perkins (3 PDP). Marin Co.: Novato, collected at UV light, 62-09-08, D.C. Rentz (1 CAS). Monterey Co.: Little Sur R., vic. P. Ocean, 70-09-06, P.D. Perkins (1 PDP). Nacimiento R., Ponderosa Public Camp, 70-09-06, P.D. Perkins (2 PDP). Hunter-Liggett M.R., Twin Valley and Coleman Reservoirs, 72-08-09, A.R. Gillogly (7 AG). Pleyto Rd. at San Antonio River, 68-04-09, Rentz and Hale (1 CAS). Napa Co.: 5 mi. SE St. Helena, Conn Lake, 65-03-29, T. Schuh (1 JS). Riverside Co.: Riverside, no date, F.E. Winters (1 CU; 16 CAS; 1 OSU). San Diego Co.: Camp Pendleton, 45-10-08, H.P. Chandler (2 CAS). Mission Vy., 33-08-19, I. Moore (1 CAS). Julian, 70-06-29, K. Stephan (1 KS). San Luis Obispo Co.: Lopez Canyon Dam Outlet, 70-09-05, P.D. Perkins (2 PDP). Santa Barbara Co.: Santa Barbara, no date, F.E. Winters (1 CU; 6 CAS). Tulare Co.: Kern R., 9.5 road mi. N. Kernville, 70-03-25, H.B. Leech (14 CAS). Nevada: Ormsby Co.: Carson City, 33-07-30, Wickham (7 USNM; 3 CAS; 2 UW; 3 MCZ). Carson, no date, F. Psota (4 CFMNH).

16. *Ochthebius richmondi* new species

Map: Figure 117B

Paratypes: 117

United States: California: Humboldt Co.: Same data as Holotype (7 CAS). Blue Lake, 07-06-20, Bradley (96 CU). Washington: King Co.: North Bend, Maloney's Grove, 31-05-16, M.H. Hatch (14 UWA).

17. *Ochthebius costipennis* Fall

Map: Figure 117A

Specimens examined: 11

United States: California: San Benito Co.: San Benito River, 55-06-18, P.S. Bartholomew (1 CAS; 1 PDP). Pinnacles Nat. Mon., 1000', 46-05-03, H.P. Chandler (1 CAS). Santa Barbara Co.: Santa Barbara, no date, F.E. Winters (2 CAS; 1 CU; 1 MCZ). Lompoc, no date, F. Winters (1 PDP; 2 CAS). Clear Cr., Cuyama Cyn., 37-03-07, H.B. Leech (1 CAS).

18. *Ochthebius crenatus* Hatch

Map: Figure 117A

Specimens examined: 19

United States: California: Willow Cr. just above its E. fork, 1500', 70-08-29, H.B. Leech (1 CAS). Placer Co.: Lake Tahoe, no date, Hubbard and Schwarz (1 CAS). Idaho: Latah Co.: Boville, 32-06-18, M.H. Hatch (2 UWA). Oregon: Jackson Co.: Union Creek, 3100-3500', 50-09-01, B. Malkin (1 CFMNH). Lake Co.: Crooked Cr., 19 mi. N. Lakeview, 55-06-07, J. Schuh (4 UWA; 8 JS). Lakeview, 52-06-22, B. Malkin (1 UWA). Unspecified Co.: Wilson River, coast

range, 45-07-08, K.M. Fender (1 UWA).

20. *Ochthebius attritus* LeConte

Map: Figure 92A

Specimens examined: 635

Colombia: Atlantico: Barranquilla, 69-03-18, P. & P. Spangler (1 USNM). Magdalena: 8 km E. Barranquilla, 69-03-19, P. & P. Spangler (46 USNM). Isla Salmanca Parque Nat., 8 km W. Santa Marta, 68-02-27, B. Malkin (1 USNM).

Cuba: Oriente, Mayari Abajo, Loma la Bandera, 73-03-29, V. Decu (1 USNM).

Dominican Republic: Barahona, 38-09-15, Darlington (27 MCZ).

Mexico: Yucatan: Progresso, beneath debris on seashore, 71-05-07, E. Anderson (1 CAS).

Puerto Rico: Playa Salina nr. Corozo, in salt water, 61-08-13, Flint & Spangler (480 USNM).

United States: Florida: Brevard Co.: Titusville, no date, no collr. (1 CAS; 1 CNC). Lee Co.: Koreshan St. Pk., 19 mi. S. Ft. Myers, B.L. Trap, 68-06-08, F.E. Wood (5 USNM). Monroe Co.: Everglades Natl. Park, 5 mi. N. Flamingo, Snake Bight Trail, sawgrass-mangrove area, 65-08-27, W. Suter (2 PDP). Big Pine Key, 77-01-06, W.E. Steiner (57 USNM). Okeechobee Co.: Mouth of Kissimmee River, 39-04-06, J.C. Bradley (1 CU). Texas: Cameron Co.: Brownsville, 04-06-03, H.S. Barber (10 USNM). Brownsville, Esprza Ranch, no date, no Collr. (1 CU).

21. *Ochthebius batesoni* Blair

Map: Figure 180

Specimens examined: 52

Ecuador: Galapagos Islands: James Bay, Espumilla Beach, Lagoon, 73-07-01, F.N. Young (30 USNM; 10 FNY; 10 PDP). Flamingo intestine, Flamingo collected on Isabel Island, Poza del Cementario Lagoon, 76-11-06, R.W. Tindle (2 USNM).

22. *Ochthebius sculptoides* new species

Map: Figure 123B

Paratypes: 242

Mexico: Aguascalientes: Aguascalientes, 63-08-05, P.J. Spangler (16 USNM). Durango: San Juan del Rio, 64-06-27, P.J. Spangler (1 USNM). Morcillo, 64-06-28, P.J. Spangler (1 USNM). San Luis Potosi: Rio Borgues, stream, 57-06-19, D. Lauck (2 USNM). Sinaloa: Culiacan, 29 mi. S., 63-06-23, J. Doyen (1 UCB). Zacatecas: 29 mi. NW Zacatecas, stream in desert, 74-07-16, M.E. & P.D. Perkins (12 PDP).

United States: Arizona: Cochise Co.: Wood Cn., Bisbee, UV light, 61-07-03, P.H. Johnson (2 UA). Yavapai Co.: Bumble Bee, 19-05-20, E. Schiffel (1 CAS). Unspecified Co.: No site, no date, no collr. (6 ASP). California: Colusa Co.: Little Stony Cr. at Lodoga-Stonyford Rd., 71-04-07, H.B. Leech (1 CAS). Little Stony Cr., 6 mi. S. Stonyford, 56-03-29, H.B. Leech (5 CAS). Fresno Co.: Waltham Cr. by Rt. 198, 515 road mi. SW of Coalinga, 70-03-27, H.B. Leech (1 CAS). Glenn Co.: Salt Cr. at Stony Cr. N. of Stonyford, 56-03-29, H.B. Leech (2 CAS). Trib. to Stony Cr., 7 mi. N. Stonyford, 56-03-29, H.B. Leech (1 CAS). Inyo Co.: Shoshone, no date, no collr. (2 CAS). Monterey Co.: Lewis Cr., 52-08-29, H.B. Leech (2 CAS). Bryson, 63-04-09, Rentz and Hale (1 UCB). Napa Co.: Pope Cr. at Walter Springs Rd., 520', 64-08-31, H.B. Leech (2 CAS). San Benito Co.: Pinnacles Natl. Monument, 1000', 46-03-05, H. Chandler (1 CAS). Clear Cr., 10 mi. WSW New Idria mine, 69-08-15, V. Lee and S.C. Williams (1 CAS). Santa Barbara Co.: Santa Barbara, no date, F. Winters (3 CAS; 1 OSU). Santa Inez Mts., no date, F. Winters (3 OSU). Siskiyou Co.: Sugar Cr., 2.3 mi. NW of Callahan, 66-08-17, H.B. Leech (2 CAS). Stanislaus Co.: Del Puerto Cr., 4 mi. by road W. of Freewy Rt. No. 5, 71-09-03, H.B. Leech (2 CAS). Unspecified Co.: No site, no date, no collr. (1 ASP). Colorado: Rout Co.: Yampa River, 14 mi. E. Craig, Hwy 40, 6400', 67-07-13, H.B. Leech (12 CAS). Idaho: Twin Falls Co.: Magic Hot Springs, 52-07-20, B. Malkin (1 CFMNH; 1 UWA). Montana: Blaine Co.: Bear Paw Mt., no date, Hubbard and Schwarz (6 CAS). Madison Co.: Ziegler Hot Springs, 52-07-27, B. Malkin (56 CFMNH). Nevada: Lincoln Co.: Cathedral Gorge St. Park, 71-07-12, J. Doyen (1 UCB). Oregon: Crook Co.: Prineville, river in gravel but much algaceous slime, 50-07-29, B. Malkin (6 UWA). Douglas Co.: Glendale, 38-06-14, M.H. Hatch (1 UWA). Jackson Co.: Medford, 33-07-24, Wickham (5 CAS; 1 USNM; 3 UW). Medford, no date, Wickham (6 MCZ). Josephine Co.: Cave Junction, 47-05-17, B. Malkin (1 UWA). Grave Creek, 52-05-30, B. Malkin (2 UWA). Malheur Co.: Sucker Creek Canyon, 51-06-15, B. Malkin (28 CFMNH; 31 UWA). Utah: Weber Co.: Ogden, no date, Hubbard and Schwarz (2 CAS). Wyoming: Natrona Co.: Badwater Cr. at Badwater, NW of Arminto, 65-08-21, H.B. Leech (3 CAS). Fremont Co.: Burris, 10 mi. NW E. Fork Wind River, 62-08-23, H.B. Leech (5 CAS).

23. *Ochthebius sculptus* LeConte

Map: Figure 123A

Specimens examined: 147

Mexico: Baja California: Arroyo de la Purisima, 1 mi. upstream from town, 58-12-27, H.B. Leech (14 CAS). No site, no date, no collr., (1 CNC).

United States: California: Del Norte Co.: Smith River, 35-07-15, no collr. (15 UWA). Humboldt Co.: Willow Cr. 16-06-12, F.E. Blaisdell (3 CAS). N. fork Mattole River, NW of Petrolia, 65-10-02, H.B. Leech (11 CAS). Blue Lake, 07-06-20, Bradley (1 CU). Los Angeles Co.: Elizabeth Lake, 16-05-11, J.O. Martin (15 CAS). Riverside Co.: San Jacinto Mts., no date, F.E. Winters (1 CAS). San Bernardino Co.: Mojave River near Victorville, 56-02-12, R.K. Benjamin (58 CAS). Hesperia, 18-06-30, J.O. Martin (12 CAS). Sonoma Co.: 5.5 mi. E. of Guerneville, no date, P. Rubtzoff (3 CAS). Trinity Co.: Mad river, 6 mi. S. Ruth, 60-07-31, H.B. Leech (2 CAS). South Fork Trinity River, Salmon Rock Camp, Hyampon-Big Slide road, 68-07-23, H.B. Leech (4 CAS). Oregon: Curry Co.: Pistol River, 50-09-18, B. Malkin (6 UWA). Douglas Co.: S. Umpqua River at Canyonville, 71-07-17, P.D. Perkins (1 PDP).

24. *Ochthebius tubus* new species

Map: Figure 135B

Paratypes: 282

Mexico: Baja California: Arroyo de la Purisima, 1 mi. upstream from town, 58-12-27, H.B. Leech (2 CAS). 3.2 mi. S. Colonia Guerrero, 63-04-24, H.B. Leech (2 CAS). La Suerte, Sierra San Pedro Martir, pool in canyon, 3700', 63-06-04, R.K. Benjamin (11 CAS). 8 mi. upstream from Hamilton Ranch, dam site, 63-04-23, H.B. Leech (2 CAS). San Luis Potosi: 2 mi. S. San Luis Potosi, 48-11-21, H.B. Leech (2 CAS). Rio Borques, stream, 57-06-19, D. Lauch (3 USNM). Tamaulipas: Nr. San Antonio, 69-07-27, F.N. Young (6 USNM).

United States: Arizona: Gila Co.: 26 mi. N. Roosevelt, Tonto Creek, 66-04-06, J. Schuh (1 JS). Mojave Co.: Peach Springs, no date, no collr. (1 CAS). California: Alameda Co.: Arroyo d. Valle, 72-03-06, W.J. Tyson (8 RG). Humboldt Co.: South Eel River at Weott, 155', 70-08-30, H.B. Leech (1 CAS). Lake Co.; Hidden Lake, 4 mi. NW Lakeport, 55-08-05, H.B. Leech (1 CAS). Los Angeles Co.: San Gabriel River, Rincon Station, 1800', 70-08-29, P.D. Perkins (9 PDP). San Gabriel River, Rincon Station, 1800', 71-04-17, P.D. Perkins (12 PDP). San Gabriel River, Cogswell Res., 2400', 71-03-28, P.D Perkins (15 PDP). San Gabriel River, 4 mi. N. Azuza, 71-04-17, P.D. Perkins (12 PDP). Pasadena, no date, F.E. Winters (1 CAS). Palmdale, 18-06-09, J.O. Martin (12 CAS). San Dimas, 49-01-01, K.R. Hobbs (6 ORSU). Mendocino Co.: No site, 18-11-03, E.R. Leach (4 CAS). Monterey Co.: Carmel River, 50-08-20, P.S. Bartholomew (14 CAS). Carmel, 31-07-18, no collr. (1 CAS). Nacimiento R., Ponderosa Public Camp, 70-09-06, P.D. Perkins (3 PDP). Hunter Ligget, Nacimiento R., 73-05-25, A.R. Gillogly (3 AG). Bryson, 63-04-09, Rentz & Hale (1 MCZ). Napa Co.: Pope Cr. at Walter Springs Rd., 520', 64-08-24, H.B. Leech (15 CAS). Orange Co.: Upper Trabuco Cyn., 70-02-18, P.D. Perkins (1 PDP). Riverside Co.: San Jacinto Mts., no date, F.E. Winters (1 CAS). San Diego Co.: Camp Pendleton, Oceanside, 45-10-18, H.P. Chandler (4 CAS). San Diego, no date, F.E. Blaisdell (24 CAS). Dulzura Cr., 1 mi. S. Dulzura, 7007-20, P.D. Perkins (1 PDP). San Joaquin Co.: Manteca, 52-08-24, P.S. Bartholomew (1 CAS). San Luis Obispo Co.: Lopez Canyon Dam outlet, 70-09-05, P.D. Perkins (4 PDP). Santa Barbara Co.: Santa Barbara, Santa Inez Mts., no date, F.E. Winters (18 CAS; 1 CU). Tulare Co.: 2 mi. N. Kennedy Mdws., 70-05-09, P.D. Perkins (45 PDP). 3 mi. NW Kennedy Mdws., Fish Cr., 70-05-10, P.D. Perkins (2 PDP). Yolo Co.: Winters, 46-08-22, H.P. Chandler (1 CAS). Montana: Blaine Co.: Bear Paw Mt., no date, Hubbard & Schwarz (2 USNM). Oklahoma: Woods Co.: 3 mi. W. Waynoka, old road to Herman, at light 67-08-11, H.B. Leech (1 CAS). Texas: Uvalde Co.: Uvalde, 930', 33-06-20, Wickham (1 USNM). Val Verde Co.: Del Rio, 955', 33-06-27, Wickham (19 USNM; 6 MCZ). Wyoming: Crook Co.: Devil's Tower Nat'l. Mon., Belle Fourche River, 62-08-13, P.J. Spangler (2 USNM).

25. *Ochthebius alpinopetrus* new species

Map: Figure 99B

Paratypes: 14

United States: Colorado: Fremont Co.: Canon City, no date, Wickham (1 ASP). Wyoming: Natrona Co.: Same data as Holotype (5 CAS; 2 USNM; 1 CNC; 2 PDP). Park Co.: Meeteetse, 52-08-03, B. Malkin (3 CFMNH).

26. *Ochthebius spanglerorum* Wood and Perkins

Map: Figure 99B

Specimens examined: 135

United States: Colorado: Fremont Co.: Canon City, no date, Wickham (1 CAS). Montezuma Co.: Navajo Spring Creek, 72-08-04, P.D. Perkins (11 USNM). New Mexico: Lincoln Co.; 5 mi. N. Angus, Hwy. 37, 7050', 65-08-07, H.B. Leech (31 CAS; 4 USNM). Torrance Co.: 10 mi. SW Mountainair, stream by Abo State Mon., 67-08-21, H.B. Leech (7 CAS). North Dakota: Williams Co.: Williston, no date, Wickham (1 CAS). Utah: Emery Co.: San Rafael Swell, 5000', 40-11-05, H.P. Chandler (3 CAS). Washington Co.: St. George, no date, Wickham (4 CAS; 5 USNM; 4 MCZ). Leeds, 33-08-07, Wickham (22 USNM; 4 CAS; 6 MCZ). Wayne Co.: 14 mi. S. Hanksville, light, sand-oak area, 68-08-03, H. & A. Howden (5 CNC). Wyoming: Bighorn Co.: Mouth of Shell Cyn. at Shell, 4230', 64-07-25, H.B. Leech (1 CAS). Carbon Co.: Medicine Bow, 41-08-22, H.P. Chandler (2 CAS). Johnson Co.: S. fork of Crazy Woman Cr., 64-07-27, H.B. Leech (1 CAS). Natrona Co.: Dugout Cr., 8.5 mi. NW of Midwest, 64-07-27, H.B. Leech (19 CAS). Sweetwater Co.: 10 mi. W. Rock Springs, Hwy. 30, Ox-bow cut-off of Bitter Cr., 65-08-23, H.B. Leech (4 CAS).

27. *Ochthebius aztecus* Sharp

Map: Figure 121

Specimens examined: 524

Mexico: Distrito Federal: Mexico City, 59-07-30 Drake & Hotles (1 USNM). Durango: Morcillo, 64-06-28, P.J. Spangler (2 USNM). Mexico: Chapingo, en arena de rio, 59-02-01, I. Martell (10 USNM). Puebla: Lag. Totolzingo, Rt. 136, km 200, 66-08-02, Flint & Ortiz (1 USNM). Lago Alchichica, 48-12-19, H.B. Leech (1 CAS).

United States: Arizona: Cochise Co.: Wilcox Playa, 69-11-02, K. Stephan (7 KS). Wilcox, 68-04-28, K. Stephan (2 KS). California: Inyo Co.: Tecopa, freshwater S. Francis (near Grimshaw) Lake, 64-03-24, H.B. Leech (1 CAS). Drainage of Carson Slough, Amargosa Desert, 2.3 mi. NE Death V. Junction, 2045', 67-03-22, H.B. Leech (60 CAS). Pool in dry bed of Amargosa River, 7.8 mi. S. of Death Valley Junction, 67-03-22, H.B. Leech (3 CAS). Deep Springs, Deep Springs Valley, ca. 19 air mi. E. Bishop, 71-02-01, D. Giuliani (16 CAS). Deep Springs Valley, Buckhorn Springs, 71-04-22, D. Giuliani (3 CAS). Tecopa, 71-12-26, D. Giuliani (20 CAS). Los Angeles Co.: E. fork San Gabriel River, San Gabriel Mts., 69-04-25, P.D. Perkins (1 PDP). Mono Co.: Travertine Hot Spgs., 2 mi. SE Bridgeport, 63-08-15, H.B. Leech (81 CAS). Bridgeport, no date, Wickham (1 CAS). Bridgeport, 6465', 15-06-12, Wickham (2 MCZ; 24 USNM). San Bernardino Co.: Death Valley NM, Saratoga Spring, 70-10-12, P.D. Perkins (5 PDP). Siskiyou Co.: Macdoel, 67-06-12, J. Schuh (1 JS). Indian Tom Lake, 55-05-30, J. Schuh (202 JS). As above, 67-05-03, J. Schuh (7 JS). As above, 66-09-27, J. Schuh (1 JS). Nevada: Eureka Co.: Beowawe, hot spring No. 24, 38-08-01, no collr. (2 USNM; 7 MCZ; 2 CAS). Nye Co.: Clay Camp, Ash Meadows, 64-03-25, H.B. Leech (1 CAS). Ash Meadows, 70-10-10, P.D. Perkins (1 PDP). New Mexico: Bernalillo Co.: Albuquerque, no date, no collr. (1 CDMNH; 1 CNC; 1 SDSU; 2 CAS). Albuquerque, no date, Wickham (1 UW; 2 USNM). Unspecified Co.: No site, no date, no collr. (2 MCZ; 3 CFMNH). North Dakota: Bottineau Co.: Lake Metigoshe, 63-05-23, R. Gordon (1 USNM). Slope Co.: No site, 62-09-13, R. Gordon & R.L. Post (1 USNM). Oregon: Harney Co.: Hot Spgs., SE shore of Harney Lake, 51-06-20, B. Malkin (1 UWA). 20 mi. E. Fields, creek 59-06-24, K. Goeden (1 UWA). Klamath Co.: Lower Klamath Lake, 55-05-30, T. Schuh (3 UWA). Lower Klamath Lake, in alkaline lake, 55-05-30, J. Schuh (3 UWA). Lower Klamath Lake, alkali lake, 58-06-21, J. Schuh (1 JS). As above, 55-05-30 (8 JS). Lake Co.: Abert Lake, 57-04-28, J. Schuh (3 JS; 1 UWA). Lakeview, 51-08-28, B. Malkin (2 UWA). Utah: Salt Lake Co.: Saltair, 4000', 41-07-15, H.P. Chandler (18 CAS). Salt Lake, no date, H.S. Barber (1 USNM). Salt Lake, no date, Hubbard & Schwarz (1 USNM). Weber Co.: No site, 57-07-16, G.F. Knowlton (1 OSU).

28. *Ochthebius biincisus* new species

Map: Figure 127B

Paratypes: 32

United States: California: Alameda Co.: Arroyo d. Valle, 72-03-06, B. Malkin (1 CFMNH). Del Norte Co.: No site, 10-06-01, Nunenmacher (3 CFMNH). Humboldt Co.: Korbel, 16-06-18, F.E. Blaisdell (3 CAS; 1 CFMNH). Pepperwood, Eel River, 38-05-16, H.B. Leech (2 CAS). Marin Co.: Lake Lagunitas, 19-09-01, J.O. Martin (1 CAS). Mendocino Co.: Pieta Cr. at Route 101, Pieta, 465', 70-08-31, H.B. Leech (1 CAS). Eel River R.S., 7 mi. W., 1450', 72-06-10, S.L. Szerlip (2 UCB). Monterey Co.: Little Sur R., vic. Pacific Ocean, 70-09-06, P.D. Perkins (15 PDP). Siskiyou Co.: North Fork Salmon River, 5 mi. NE forks of Salmon, 68-07-26, H.B. Leech (2 CAS). Oregon: Curry Co.: Pistol River, 56-09-17, B. Malkin (1 CFMNH).

29. *Ochthebius gruwelli* new species

Map: Figure 127B

Paratypes: 27

Mexico: Baja California: Sierra San Pedro Martir, La Grulla, 6900', 53-06-12, P.H. Arnaud, Jr. (2 CAS). Norte,

Sa. Juarez, 1 mi. S. Laguna Hanson, 5000', 70-07-19, P.D. Perkins (1 PDP). Norte, Sa. Juarez, 20 mi. N. El Rodeo, 70-03-26, J.A. Gruwell & P.D. Perkins (1 PDP). Norte, San Pedro Martir, Cyn. Diablito, 70-03-27, J.A. Gruwell & P.D. Perkins (1 PDP).

United States: California: Los Angeles Co.: Pasadena, no date, F. Winters (1 PDP). Wickiup Public Camp, 70-08-01, P.D. Perkins (2 PDP). San Gabriel River, E. Fork, Mine Gulch Public Camp, 4500', 70-07-26, P.D. Perkins (4 PDP). San Gabriel River, W. Fork Sta., 3100', 70-08-01, P.D. Perkins (2 PDP). As above, 71-11-01 (4 PDP). San Gabriel River, N. Fork, Coldbrook Sta., 3600', 71-02-27, P.D. Perkins (3 PDP). Riverside Co.: San Jacinto Mts., no date, F. Winters (1 CAS). Palm Canyon, 16-04-15, J.O. Martin (2 CAS; 2 PDP). Ventura Co.: Sespe Cr., Sespe Gorge, 3500', 72-06-18, P.D. Perkins (1 PDP).

30. *Ochthebius arizonicus* new species

Map: Figure 127B

Paratypes: 17

United States: Cochise Co.: Huachuca Mts., 37-11-03, O. Bryant (1 CAS). Gila Co.: 19 mi. N. Roosevelt, Sycamore Cyn., 66-04-06, J. Schuh (2 JS; 2 CAS; 4 PDP). 26 mi. N. Roosevelt, Tonto Cr., 66-05-06, J. Schuh (1 PDP). Pinal Co.: Tortolita Mts., Cottonwood Cyn., 69-12-14, K. Stephan (2 KS; 4 PDP). Yavapai Co.: Bumble Bee, 19-05-20, E. Schiffel (1 CAS).

31. *Ochthebius madrensis* new species

Map: Figure 127A

Paratypes: 11

Mexico: Durango: 9 mi. E. Los Bancos, ca 90 mi. W. Durango, stream, pine forest meadow, 74-07-17, M.E. & P.D. Perkins (3 PDP).

United States: Arizona: Cochise Co.: Portal, Southwest Research Station, 76-05-14, W.E. Steiner (5 USNM). W. Turkey Cr. Camp, Chiricahua Mts., UV lite, 5900', 64-06-15, J. Burger (1 UA). Santa Cruz Co.: Santa Rita Mts., Madera Cyn., 68-06-22, K. Stephan (1 KS). Pajarito Mts., Sycamore Cyn., 68-08-24, K. Stephan (1 KS).

33. *Ochthebius mexcavatus* new species

Map: Figure 127A

Paratypes: 135

Mexico: Durango: Same data as Holotype (5 CAS; 30 USNM; 5 CNC; 5 MCZ; 80 PDP). 1 mi. E. Los Bancos, ca 98 mi. W. Durango, stream in pine forest, 74-07-17, M.E. & P.D. Perkins (2 PDP). 9 mi. E. Los Bancos, ca 90 mi. W. Durango, stream, pine forest meadow, 74-07-17, M.E. & P.D. Perkins (5 PDP). Sinaloa: 1 mi. W. El Palmito, stream in pine forest, 74-07-19, M.E. & P.D. Perkins (2 PDP). Sonora: 7 mi. SE Alamos, 71-11-27, K. Stephan (1 KS).

34. *Ochthebius obscurus* Sharp

Map: Figure 130

Specimens examined: 6

Mexico: Guanajuato: Guanajuato (two female syntypes, one each in BMNH and USNM). Hidalgo: 2 mi. N. Zimapan, intermittent desert stream, 74-05-21, M.E. and P.D. Perkins (2 females PDP). Mexico: 11 mi. S. Valle de Bravo, stream in deciduous-pine forest, 74-07-12, M.E. and P.D. Perkins (1 male, 1 female PDP).

35. *Ochthebius mesoamericanus* new species

Map: Figure 130

Paratypes: 85

Guatemala: Baja Verapaz: 10 mi. S. Rabinal, 74-06-12, ME & PD Perkins (2 PDP). Huehuetenango: 35 mi. S. La Mesilla, tropical brook, 74-05-31, ME & PD Perkins (3 PDP). Jalapa: 45 mi. E. Jalapa, small pool at base of waterfall, 74-06-14, ME & PD Perkins (3 PDP). Totonicapan: 25 mi. S. Huehuetenango, small, rapid stream, 74-06-01, ME & PD Perkins (3 PDP).

Mexico: Chiapas: 27 mi. N. Comitan, somewhat muddy stream, 74-07-01, ME & PD Perkins (6 USNM: 6 PDP). Durango: 9 mi. E. Los Bancos, ca 90 mi. W. Durango, stream, pine forest meadow, 74-07-17, ME & PD Perkins (20

USNM: 30 PDP). 10 mi. W. El Salto, 64-06-10, E.E. Lindquist (1 CNC). Jalisco: 7 mi. S. Mazamitla, stream in pine forest, 74-07-15, ME & PD Perkins (1 PDP). San Luis Potosi: Quinta Chilla near Tamazunchale, 48-12-21, H.B. Leech (8 CAS). Sinaloa: 1 mi. W. El Palmito, stream in pine forest, 74-07-19, ME & PD Perkins (1 PDP). Sonora: 7 mi. SE Alamos, 71-11-27, K. Stephan (1 KS).

36. *Ochthebius benefossus* LeConte

Map: Figure 99C

Specimens examined: 39

Canada: Ontario: Dundas, 31-05-31, W.J. Brown (5 CNC). Walsh, 31-06-10, W.J. Brown (7 CNC). Quebec: Knowlton, 28-06-19, G.H. Fisk (1 CNC).

United States: Indiana: Lawrence Co.: No site, 10-07-16, W.S. Blatchley (2 USNM). Maryland: Harford Co.: Rocks, 60-09-02, P.J. Spangler (10 USNM). Garrett Co.: Deep Creek Lake, 65-06-13, R. Gordon (1 RG). New Jersey: Unspecified Co.: No site, no date, no collr. (2 ASP). Pennsylvania: Westmoreland Co.: St. Vincent, no date, no collr. (2 USNM). Vermont: Bennington Co.: No site, no date, no collr. (2 ASP). Virginia: Fairfax Co.: Dead Run, in wet Hypnum moss, 14-11-14, R.C. Shannon (7 USNM).

37. *Ochthebius discretus* LeConte

Map: Figure 135A

Specimens examined: 922

Canada: British Columbia: Metlakatla, no date, no collr. (3 CAS). Victoria, Van. Id., no date, Hubbard & Schwarz (2 CAS; 1 ASP; 2 USNM).

Mexico: Baja California: La Suerte, Sierra San Pedro Martir, 3700', pool in canyon, 63-06-04, R.K. Benjamin (1 CAS).

United States: California: Alameda Co.: Arroyo d. Valle, 72-03-06, W.H. Tyson (8 RG). Berkeley, no date, F.E. Winters (1 CAS). No site, 06-06-01, Nunenmacher (3 CFMNH). Calaveras Co.: Mokelumne Hill, no date, F.E. Blaisdell (1 CAS). Calaveras Big Trees, 37-09-13, F.E. Blaisdell (12 CAS). Colusa Co.: Paradise Cr., 2400', 53-10-14, H.P. Chandler (1 CAS). Contra Costa Co.: Bryant, 35-08-04, I. Moore (1 CAS). Hills back of Oakland, 11-05-14, no collr. (8 CAS). Danville, 51-06-01, F.X. Williams (10 CAS). Perkins Gulch, 7 mi. SE Clayton, 66-07-22, J. Doyen & P. Opler (1 UCB). S.F. Bay area, no date, D. Giuliani (1 CAS). Mt. Diablo, 19-09-21, J.O. Martin (5 CAS). Del Norte Co.: No site, 10-06-10, Nunenmacher (5 CFMNH). El Dorado Co.: Riverton, 72-06-15, no collr. (1 CAS). Fresno Co.: Bass Lake, 34-04-01, no collr. (1 CAS). Glenn Co.: N. Fork Stony Creek, 0.5 mi. W. of Newville, 66-04-04, H.B. Leech (1 CAS). NW corner Glenn Co., 6500', 4.5 mi S. of Mendocino Pass, 60-07-29, H.B. Leech (6 CAS). Black Butte, 6500-7400', 72-06-16, J. Doyen (2 UCB). Humboldt Co.: Hydesville, 01-06-01, no collr. (4 CAS). Arcata, 01-07-01, no collr. (1 CAS). No site, no date, no collr. (4 CAS). Roaring Gulch Cr., Redwood Valley, ca 5 mi. N. Hoopa Rd., 70-08-14, H.B. Leech (1 CAS). Toss-up Creek, confluence with Redwood Cr., 2.5 mi. N. of road to Hoopa, 650', 70-08-13, H.B. Leech (1 CAS). Willow Creek just above its E. Fork, 1500', 70-08-29, H.B. Leech (4 CAS). Pepperwood, Eel River, 38-05-16, H.B. Leech (1 CNC; 1 CU; 6 CAS). Van Duzen River, 8.8 mi. W. Bridgeville, 66-08-07, H.B. Leech (1 CAS). Mill Cr., 7.5 mi. S. of Bridgeville, 1200', 68-07-19, H.B. Leech (11 CAS). South Dobbyn Creek, Alderpoint-Blocksburg road, 450', margin of Typha pool, 68-07-19, H.B. Leech (1 CAS). Willow Creek, 16-06-12, F.E. Blaisdell (10 CAS). Korbel, 16-06-17, F.E. Blaisdell (2 CAS). Lake Co.: Creek behind Cottage City Resort, Lucerne, 53-07-05, H.B. Leech (2 CAS). 0.6 mi. SE of Glenbrook, pool in dry stream bed, trib. of Kelsey Cr., 66-05-30, H.B. Leech (4 CAS). Rice Fork of Eel River at Crabtree Hot Springs, 57-08-09, H.B. Leech (1 CAS). L. Blue Lake, 1500', 47-11-08, H.P. Chandler (1 CAS). Lassen Co.: Norval Flats, 5500', 20-07-25, J.O. Martin (1 CAS). Manzanita Lake, 41-06-17, C. Michener (2 CAS). Los Angeles Co.: Los Angeles, collected from moss bedding (Lilac), 32-10-17, no collr, (1 CAS). Los Angeles, no date, no collr. (2 CAS). No site, no date, no collr. (2 CAS). Madera Co.: Sugar Pine, no date, A. Fenyes (1 CAS). Marin Co.: Mill Valley, Cascade Creek, 51-05-09, R.E. Leech (22 CAS). Olema, 48-03-01, H.P. Chandler (1 CAS). Bolinas, 06-09-10, no collr. (7 CAS). Mill Valley, 04-06-15, no collr. (1 CAS). Lagunitas Cyn., 19-11-08, J.O. Martin (2 CAS). Lagunitas, 22-09-01, F.E. Blaisdell (4 CAS). Fairfax, no date, F.E. Blaisdell (1 CAS). Inverness, stream, 51-05-16, H.B. Leech (30 CAS). Lagunitas, 08-06-14, no collr. (3 CAS). Muir Woods, 08-08-30, no collr. (1 CAS). 10 mi. E. Marshall, Marshall-Petaluma Rd., roadside marsh, 64-02-22, H.B. Leech (1 CAS). Lagunitas Lake, 2000', 46-08-14, H.P. Chandler (1 CAS). Cataract Creek, Rock Spring, Mt. Tamalpais, 52-05-25, H.B. Leech (18 CAS). Novato, stream bed by sifting, 52-06-17, H.B. Leech (4 CAS). San Rafael, 50-06-25, P.S. Bartholomew (5 CAS). Pool at culvert, Tocaloma, 68-05-04, H.B. Leech (5 CAS). Lagunitas Creek at Tocaloma, 68-05-04, H.B. Leech (36 CAS). Marshall, stream, N. end of town at Highway No. 1, 63-10-20, H.B. Leech (1 CAS). Bootjack Cyn., Muir Woods, edge of stream, 52-05-21, no collr. (1 CFMNH). Muir Woods, 52-05-21, no collr. (2 CFMNH). Mill Valley, 52-05-17, H. Dybas (1 CFMNH). Mariposa Co.: Chowchilla Mt. rd., stream at ca. 4600', trib. Chowchilla R., 71-08-03, H.B. Leech (6 CAS). NE slope Chowchilla Mts., 6100', bog by Stove Pipe

Campground, 71-08-06, H.B. Leech (1 CAS). Miami Ranger Station, 5000', 42-06-07, H.P. Chandler (1 CAS). Yosemite, 7000', 34-05-20, Bryant (1 CAS). Mendocino Co.: Mendocino, 67-07-21, J.R. Helfer (3 CAS). Mendocino, 57-07-06, J.R. Helfer (1 CAS). Cold Creek, 1 mi. E. of E. Fk. Russian River, 64-10-11, H.B. Leech (1 CAS). McDowell Cr. at foot of grade below Oasis, 1000', 55-07-27, H.B. Leech (4 CAS). Eel River R. S., 53-08-14, P.S. Bartholomew (4 CAS). Rancheria Cr. 5.5 mi. SE Booneville, 50-06-15, H.B. Leech (1 CAS). 15 mi. W. Willits, stream, 48-06-15, H.B. Leech (1 CAS). 5 mi. S. of Willits, 38-05-15, H.B. Leech (1 CAS). Bloody Run Cr., 7 mi. E. of route 101 on Longvale-Covelo road, 1100', 68-07-18, H.B. Leech (5 CAS). McDowell Creek just below Oasis, 1800', 55-07-27, H.B. Leech (1 CAS). Parson Creek, 4.5 mi. NE of Hopland, 64-06-30, H.B. Leech (12 CAS). Baechtel Creek, 3 mi. W. Willits, 48-06-15, H.B. Leech (1 CAS). Eel River, 7 mi. W., 1450', 72-06-10, S. Szerlip (1 UCB). Modoc Co.: Rush Cr., 9 mi. N. Adin, 50-07-16, H.B. Leech (2 CAS). Mono Co.: Hot Creek (it was cold), 1.4 mi. W. of Fales Hot Springs, 64-08-07, H.B. Leech (4 CAS). Monterey Co.: The Indians, 2 mi. SE Santa Lucia Memorial Park, seepage trickle over gravelly soil, 56-01-16, H.B. Leech (1 CAS). Tassajara Hot Springs, 54-05-26, no collr. (1 CAS). Junipero Sierra Pk., Santa Lucia Mts., Forestry Camp Springs, ca 4900', 56-08-12, H.B. Leech (1 CAS). Carmel, 11-06-11, no collr. (1 CAS). Salinas, no date, no collr. (1 CAS). Napa Co.: Huichica Cr., 28-06-05, J.W. Tilden (2 CAS). Calistoga, 34-06-12, Bryant (4 CAS). Nevada Co.: Shotgun Lake, Bowman Mt., 6500', 23-07-13, J.O. Martin (15 CAS). Graniteville, 52-08-22, P.S. Partholomew (2 CAS). Riverside Co.: San Jacinto Mts., no date, F.W. Winters (2 CAS). Riverside, no date, no collr. (1 CAS). Riverside, no date, F.E. Winters (1 OSU). Idyllwild, 70-06-30, K. Stephan (1 KS). San Bernardino Co.: Bear Lake, 19-07-10, no collr. (1 CAS). San Benito Co.: Griswold Creek, Lyons Cyn. on road to Idria, 63-07-21, H.B. Leech (1 CAS). San Diego CO.: Cuyamaca Lake, 61-06-11, I. Moore (1 CAS). Poway, no date, F.E. Blaisdell (2 CAS). Camp Pendleton, Oceanside, 2000', 45-02-11, H.P. Chandler (1 CAS). Julian, 70-06-29, K. Stephan (1 KS). No site, no date, F.E. Blaisdell (3 CAS). San Francisco Co.: San Francisco, no date, Hubbard & Schwarz (2 USNM). San Francisco, 95-08-01, no collr. (2 MCZ). San Mateo Co.: La Honda Rd., 51-07-14, P.S. Bartholomew (1 CAS). No site, no date, no collr. (3 CAS). Santa Barbara Co.: Cuyama River ca. 10 mi. E. Santa Maria, 52-07-21, H.B. Leech (1 CAS). Santa Inez Mts., Santa Barbara, no date, F.E. Winters (2 CAS). Santa Barbara, no date, F.E. Winters (8 CAS). Santa Clara Co.: Jasper Ridge, Stanford Univ., 52-05-06, P.S. Bartholomew (101 CAS). Stanford Univ., 53-12-22, P.S. Bartholomew (1 CAS). Mts. back of Alma, 29-10-21, J.O. Martin (4 CAS). Los Gatos, no date, Hubbard & Schwarz (12 USNM). Santa Cruz Co.: Santa Cruz, no date, F.E. Blaisdell (13 CAS). Santa Cruz, 96-06-01, F. Nunenmacher (2 CFMNH). Santa Cruz Mts., no date, no collr. (10 CAS). Santa Cruz Mts., no date, A. Koebele (7 USNM). Shasta Co.: Big Springs, 4000', 47-06-26, H.P. Chandler (2 CAS). Viola, 41-05-20, no collr. (2 CAS). Hat Creek R.S., 3000', 47-06-28, H.P. Chandler (2 CAS). Viola, 4500', 47-06-27, H.P. Chandler (1 CAS). Big Spring, 41-05-29, C. Michener (1 CNC; 1 CAS). Manzanita Lake, Lassen Natl. Park, 41-06-06, C.D. Michener (6 CAS). Siskiyou Co.: Head of W. Branch Indian Cr. at Poker Flat, 5040', 66-08-14, H.B. Leech (1 CAS). Sonoma Co.: Cherney Cr., 2.8 mi. S. & E. of Bodega Bay, 63-07-01, H.B. Leech (20 CAS). Mark West Cr. at Calistoga Rd., ca 4 mi. S. of Petrified Forest, 63-07-08, H.B. Leech (10 CAS). Bennet Mt. Lk. W. of Kenwood, 1180', 68-05-26, H.B. Leech (2 CAS). Santa Rosa Cr., no date, Ricksecker (10 CAS). Duncan Mills, 08-07-21, F.E. Blaisdell (11 CAS). Sonoma, 50-04-29, H.B. Leech (2 CAS). Duncan Mills marsh, 69-07-21, P. Rubtzoff (9 CAS). No site, no date, no collr. (3 CAS). Fort Ross, 51-07-10, P.S. Bartholomew (10 CAS). Camp Meeker, 52-07-10, P.S. Bartholomew (9 CAS). Camp Meeker, no date, Wintersteiner (2 OSU; 3 CAS). Cheney Cr. 2.8 mi. S. & E. of Bodega Bay, 63-07-01, H.B. Leech (1 CAS). Tehama Co.: SW corner Tehama Co., 1 mi. SW of Government Camp, 6000', muddy pool in clear mountain stream, 60-07-29, H.B. Leech (51 CAS). Trinity Co.: Little Brown Creek at Route 3, ca 3 mi. airline SW Douglas City, 70-08-11, H.B. Leech (1 CAS). Van Horn Creek, 1.5 mi. above its mouth at upper Mad River, 2850', clear water pools and stones of otherwise dry and shaded creek bed, 70-08-09, H.B. Leech (1 CAS). Trinity Center, 36-08-23, J.T. Howell (2 CAS). Big Slide Creek, 5 mi. NW of Hyampon, 68-07-24, H.B. Leech (1 CAS). SW corner Trinity Co., Wilson Cr. Lake Mtn. area, 60-07-30, H.B. Leech (2 CAS). Tulare Co.: Kern River, 9.5 road mi. N. of Kernville, 70-03-25, H.B. Leech (2 CAS). Redwood Park, 23-08-09, J.O. Martin (15 CAS). Sequoia Natl. Park, F.E. Winters (2 OSU). Tuolumne Co.: Pinecrest, 48-07-01, P.H. Arnaud, Jr., (3 CAS). Yauba Co.: Yuba City, 42-05-10, H.P. Chandler (2 CAS). Unspecified Co.: No site, no date, no collr. (5 UNSM; 2 UW; 2 CFMNH; 10 ASP). Colorado: Costilla Co.: Veta Pass, no date, Hubbard & Schwarz (2 CAS; 1 ASP). Veta Pass, no date, F.C. Bowditch (2 MCZ). Idaho: Bingham Co.: No site, no date, Hubbard & Schwarz (4 CU; 13 USNM). Blaine Co.: Galena, 52-07-22, B. Malkin (1 UWA). Clark Co.: Birch Creek, route 28, 5.4 mi. N. of Blue Dome, 69-08-24, H.B. Leech (1 CAS). Custer Co.: 15 mi. SE of Challis, 49-07-04, H.B. Leech (1 CAS). Twin Falls Co.: Magic Hot Springs, 52-07-20, B. Malkin (1 UWA). Nevada: Elko Co.: 1000 Spring Creek, Wilkins, 49-07-03, H.B. Leech (1 CAS). Ruby Valley, no date, no collr. (2 OSU). No site, no date, no collr. (1 CU). Oregon: Benton Co.: Monroe, 30-06-18, M.H. Hatch (6 UWA). Curry Co.: Pistol River, 51-07-07, B. Malkin (1 CFMNH; 2 UWA). Port Orford, 51-07-07, B. Malkin (1 CFMNH; 1 UWA). Douglas Co.: Glendale, 38-06-14, M.H. Hatch (3 UWA). Gilliam Co.: Mayville, 38-06-21, M.H. Hatch (1 UWA). Grant Co.: Pass Cr., N. of Long Cr., 50-07-18, H.B. Leech (8 CAS). Harney Co.: Steens Mts., Fish Lake, 7500', 51-06-26, B. Malkin (1 UWA). Fish Lake, Steens Mts., 58-08-16, J.H. Baker (1 JS). Jackson Co.: Siskiyou, 51-07-05, B. Malkin (1 UWA). Lake Co.: Lakeview, 52-06-22, B. Malkin (22 CFMNH; 22 UWA). Chandler State Park, 51-06-30, B. Malkin (1 UWA). Linn Co.: Albany, 28-07-15, Wickham (1 CAS). Multnomah Co.: Portland, no date, Hubbard & Schwarz (1 USNM; 3 CAS). Umatilla Co.: 7 mi. SE Milton, 49-05-04, G.H. Nelson (1 CAS). 7 mi. SE Milton, 48-07-04, G.H. Nelson (2 UA). Wheeler Co.: Summit, Ochoco Pass, 5200', 50-07-30, B. Malkin (1 CFMNH).

10 mi. NNE Spray, NE Fk. Deadhorse Cr., 3178', 64-07-06, H.B. Leech (1 CAS). Yamhill Co.: McMinnville, 42-07-05, K.M. Fender (2 UWA). Peavine Ridge nr. McMinnville, 47-05-16, K.M. Fender (1 UWA). No site, 35-01-01, E.S. Ross (1 CAS). Utah: Cache Co.: Logan Canyon, 7200', 73-07-28, R. Gordon (2 RG). No site, 56-07-23, G.F. Knowlton (2 OSU). Garfield Co.: Escalante River, mouth of Calf Creek, 39-08-04, H.P. Chandler (1 CAS). City Can., no date, Hubbard & Schwarz (2 ASP; 1 CAS). Utah Co.: Hobble Creek Canyon, 6000', 41-07-27, H.P. Chandler (3 CAS). Aspen Grove, 38-08-15, H.P. Chandler (2 CAS). Utah Lake, east side, 4000', 41-06-14, H.P. Chandler (2 CAS). Wasatch Co.: Wasatch Mts., 47-06-28, Bryant (3 CAS). Washington: Kittitas Co. Ellensberg, 32-07-19, M.H. Hatch (1 UWA). San Juan Co.: San Juan Island, 30-08-02, M.H. Hatch (2 UWA). Friday Harbor, 26-08-06, no collr. (1 UWA). Snohomish Co.: Stillaguamish, 28-04-08, no collr. (1 UWA). Whitman Co.: Wawawai, 20-07-08, M.C. Lane (1 CU; 2 CAS). Pullman, no date, C.V. Piper (4 USNM). Pullman, no date, no collr. (1 JS; 4 UWA). Colfax, 32-06-17, no collr. (1 UWA). Wyoming: Fremont Co.: Beaver Cr. at Hwy. 28, E. slope of South Pass, 24 mi. S. & W. Lander, 65-08-22, H.B. Leech (1 CAS).

40. *Ochthebius mimicus* Brown

Map: Figure 139B

Specimens examined: 15

Canada: British Columbia: Little Sand Cr., Jaffray, 50-07-23, H.B. Leech (1 CAS; 1 UBC). Fernie, 35-08-31, H.B. Leech (1 CAS).

United States: Oregon: Multnomah Co.: Portland, no date, Hubbard & Schwarz (1 USNM). Unspecified Co.: No site, no date, no collr. (1 CU). Washington: Chelan Co.: Leavenworth, 33-07-09, Wickham (1 USNM). Kittitas Co.: Easton, no date, A. Koebele (2 USNM). Snohomish Co.: Sultan, 30-05-02, M.H. Hatch (1 UWA). Spokane Co.: Spokane, 32-08-25, M.H. Hatch (2 UWA; 2 PDP). Mead, 32-08-26, M.H. Hatch (2 UWA).

42. *Ochthebius similis* Sharp

Map: Figure 142A

Specimens examined: 10

Mexico: Hidalgo: Pachuca, 64-08-21, P.J. Spangler (1 USNM). Vera Cruz: Highway 150, 2 mi. above Acultzingo, 48-12-14, H.B. Leech (1 CAS).

United States: Arizona: Coconino Co.: Salt Creek, no date, no collr. (2 CAS). Clear Creek Canon, no date, Wickham (1 USNM). Navajo Co.: Winslow, no date, no collr. (3 CAS; 1 CNC). Winslow, no date, Wickham (1 MCZ).

43. *Ochthebius cribricollis* LeConte

Map: Figure 137

Specimens examined: 151

Canada: Alberta: Medicine Hat, 25-08-05, F.S. Carr (1 UA). British Columbia: Salmon Arm, Salmon River, 33-10-06, H.B. Leech (1 CAS). Creston, 17-05-05, W.R.S. Metcalfe (1 CAS). Osoyoos, sandy pool near Osoyoos Lake, 41-03-29, H.B. Leech (1 CAS). Edgewood, Inonoaklin River, 46-09-29, S.H. Farris (2 CAS). Lumby, 37-09-19, H.B. Leech (1 UBC). Creston, pond meadow, 54-09-27, G. Stace-Smith (2 UBC). Cawston, 17-05-05, W. Metcalfe (2 CNC). Manitoba: Treesbank, 4 mi. W. Hwy. 344, 68-08-14, R. Gordon (1 USNM). Aweme, 70-06-09, R. Gordon (1 RG). Quebec: Wakefield, 30-06-04, W.J. Brown (1 CNC).

United States: California: Lake Co.: Rocky Point, Clear Lake, 47-11-09, H.P. Chandler (2 CAS). Madera Co.: Branch, Granite Cr. 0.15 mi. W. Soldier Meadow, 6965', 71-08-17, H.B. Leech (1 CAS). Napa Co.: No site, no date, no collr. (2 CAS). Placer Co.: Lake Tahoe, no date, Hubbard & Schwarz (2 USNM). Sacramento Co.: Grand Is., 06-06-01, no collr. (1 CAS). San Luis Obispo Co.: Pismo Beach, 24-07-31, F.E. Blaisdell (1 CAS). Santa Barbara Co.: Santa Barbara, no date, F.E. Blaisdell (2 UWA; 4 CAS). Santa Clara Co.: Mts. back of Alma, 29-09-29, F.E. Blaisdell (1 CAS). Tehama Co.: Red Bluff, no date, H.P. Chandler (1 CAS). Nevada: Elko Co.: Humboldt River at Halleck, 65-08-26, H.B. Leech (1 CAS). North Dakota: Bottineau Co.: No site, 62-07-15, R. Gordon (1 USNM). Divide Co.: No site, 63-05-23, R. Gordon (2 RG). Grand Forks Co.: Northwood, Goose River, 66-07-08, R. Gordon (1 RG). Grant Co.: Lake Tschida, 70-05-31, R. Gordon (5 RG). Pierce Co.: No site, 63-05-14, R. Gordon (1 USNM). Renville Co.: Sherwood, 13 mi. West, 66-05-29, R. Gordon (1 RG). Richland Co.: No site, 64-08-19, R. Gordon (4 RG). Rolette Co.: Dunseith, nr. jct. Hwy. 3 & 43, 68-08-18, R. Gordon (2 RG). Sargent Co.: Tewaukon Ref., headq. spring, 68-08-23, R. Gordon (2 RG). Slope Co.: No site, 62-09-13, R. Gordon & R.L. Post (1 RG). Williams Co.: Willist'n, 09-06-08, Wickham (2 USNM). Oregon: Brenton Co.: Corvallis, no date, no collr. (7 MCZ). Corvallis, small pond, 56-04-08, K. Goeden (1 UWA). Columbia Co.: Scappoose, mech. trap, 37-05-01, no collr. (1 JS). Deschutes Co.: 7 mi. E. Terrebone, flood water, 56-05-09, K. Goeden (1 UWA). Jackson Co.: Union Creek, 3100-3500', 50-09-15, B. Malkin (1 UWA).

Klamath Co.: Barkley Springs, Klamath Falls, 55-06-01, J. Schuh (1 UWA). Barkley Springs, 59-09-08, J. Schuh (3 JS). 5 mi. N. Rock Point, mud bank along lake, 61-09-04, J. Schuh (5 JS). Upper Klamath Lake, under rock along shore line, 56-05-11, J. Schuh (1 JS). Mare's Egg Spring, 62-05-30, J. Schuh (2 JS). Sprague River, 12 mi. E. Chiloquin, 51-07-01, B. Malkin (4 UWA; 2 CFMNH). Spring Creek Campground, 74-07-02, R. Gordon (1 RG). Marion Co.: Salem, blk. lt. trap, 58-05-01, F.P. Larson (1 UWA). Yamhill Co.: McMinnville, 40-07-15, K.M. & D.M. Fender (1 UWA). South Dakota: Brookings Co.: Brookings, light trap, 56-07-18, H. Severin (1 SDSU). Washington: Asotin Co.: Anatone, Grande Ronde River, 32-08-29, M.H. Hatch (1 UWA). King Co.: Green River Gorge, 56-07-15, B. Malkin & R. Kottke (1 CFMNH). Evans Creek, 29-06-04, M.H. Hatch (3 UWA). Bothell, 37-07-13, G. Minsk (1 UWA). Bothell, 49-04-10, no collr. (1 UWA). Snohomish Co.: N.F. Stilaguamish River, Cicero, 27-08-21, M.H. Hatch (1 UWA). Whitman Co.: Ewan, 32-08-27, M.H. Hatch (23 UWA). Malden, 32-08-26, M. H. Hatch (1 UWA).

44. *Ochthebius brevipennis* new species

Map: Figure 139A

Paratypes: 31

Canada: British Columbia: Agassiz, 31-03-07, H.B. Leech (1 CAS).

United States: California: Mendocino Co.: Garcia River at Highway 1, 64-10-12, H.B. Leech (1 CAS). 2 mi. N. Fort Bragg, marshy pond, MacKerricher St. Pk., 67-03-31, Schuh & Vertrees (4 JS). Oregon: Benton Co.: Corvallis, small pond, 56-04-08, K. Goeden (3 ODA). Deschutes Co.: 7 mi. E. Terrebonne, flood water, 56-05-09, K. Goeden (1 ODA). Klamath Co.: 5 mi. N. Rocky Point, mud bank along lake and sweeping marsh, 61-09-04, J. Schuh (2 UWA). Tillamook Co.: Tierra Del Mar, under rocks by lake, 38-07-27, no collr. (4 CAS). Yamhill Co.: Carlton Lake, 38-03-13, no collr. (1 CAS). 4 mi. S. Newberg, black-lite trap, 69-08-11, no collr. (1 ODA). 5 mi. NE Newberg, black-lite trap, 66-06-22, K. Goeden (1 ODA). Washington: Cowlitz Co.: Silver Lake, 32-07-23, no collr. (6 USNM). Unspecified Co.: Lake A., 33-07-08, T. Kincaid (6 USNM).

45. *Ochthebius apache* new species

Map: Figure 142A

Paratypes: 43

Mexico: Zacatecas: 29 mi. SW Zacatecas, stream in desert, 74-07-16, ME & PD Perkins (1 PDP).

United States: Arizona: Cochise Co.: Huachuca mts., Upper Carr Cyn., spring, 73-08-29, A.R Gillogly (2 AG; 8 USNM; 4 PDP). Southwestern Research Sta., 64-10-24, P.H. Arnaud, Jr. (2 CAS). Huachuca Mts., Carr Cyn., 7100', 72-05-03, A.R. Gillogly (2 AG; 4 USNM; 2 PDP). Chiric Mts., no date, Hubbard & Schwarz (2 USNM). Chiricahua Mts., 8300', 68-10-05, K. Stephan (3 KS). Rustler Park, Chiricahua Mts., 8300', 52-08-26, B. Malkin (4 CFMNH). Rustler's Park, 56-07-08, F.N. Young (3 FNY). New Mexico: Dona Ana Co.: Organ Mts., no date, no collr. (1 USNM). Texas: Brewster Co.: Big Bend Nat. Pk., Boot Spring, 7000', 59-05-18, Howden & Becker (3 CNC). Big Bend N.P., Pulliam Canyon, 45-6500', W.R. Mason (2 CNC).

49. *Ochthebius apicalis* Sharp

Map: Figure 142B

Specimens examined: 10

Guatemala: Huehuetenango: 35 mi. S. La Mesilla, tropical brook, 74-05-31, ME & PD Perkins (1 PDP).

Mexico: Chiapas: El Chorreadero, Chiapa de Corzo, 64-11-03, H.P. Brown and C.M. Shoemake (1 USNM). 27 mi. N. Bochil, stream in pine forest, 74-05-27, ME & PD Perkins (2 PDP). Veracruz: Cordoba, no date, A. Fenyes (6 CAS).

50. *Ochthebius puncticollis* LeConte

Map: Figure 135C

Specimens examined: 219

Mexico: Baja California: Sa. Juarez, 2.2 mi. SE El Topo, 70-03-25, J.A. Gruwell & P.D. Perkins (4 PDP). La Suerta, Sierra San Pedro Martir, 3700', pool in canyon, 63-06-03, R.K. Benjamin (2 CAS).

United States: Arizona: Navajo Co.: Carrizo, 70-05-31, K. Stephan (3 KS). Pinal Co.: Riverside, no date, Wickham (1 USNM). Pinal Mts., Craig Ranch, 57-05-20, F.H. Parker (1 UA). Unspecified Co.: No site, no date, no collr. (2 ASP). California: Contra Costa Co.: Sleepy Hollow, Orinda, stream, 38-05-03, H.B. Leech (1 CNC; 3 CAS). Humboldt Co.: Korbel, 16-06-17, F.E. Blaisdell (1 CAS). Willow Creek, 16-06-14, F.E. Blaisdell (1 CAS). Redwood Creek,

Redwood Valley, 3 mi. N. of road to Hoopa, 650', 70-08-12, H.B. Leech (1 CAS). Willow Creek just above its E. Fork, 1500', 70-08-29, H.B. Leech (3 CAS). Mill Creek, 7.5 mi. S. of Bridgeville, 1200', 68-07-19, H.B. Leech (25 CAS). Los Angeles Co.: San Gabriel River, W. Fork Station, 3100', 70-08-01, P.D. Perkins (20 PDP). San Gabriel River, Whittier, 44-05-05, E. Sevy (2 CAS). Santa Monica, 17-03-17, J.O. Martin (1 CAS). Marin Co.: McClures Bch., Pt. Reyes Pen., 61-07-07, H.B. Leech (22 CAS). Point Reyes National Seashore Firebreak trail between Sky Camp & Coast Camp, 68-05-01, P.S. Bartholomew (2 CAS). Lagunitas creek at Tacoloma, 68-05-04, H.B. Leech (17 CAS). Mendocino Co.: Mendocino, amongst roots *Mimulus guttatus*, 57-07-06, J.R. Helfer (8 CAS). Mendocino, 57-07-21, J.R. Helfer (24 CAS). James Creek, Hwy. 20, 12.5 mi. W. of Willits, 64-10-11, H.B. Leech (6 CAS). No site, no date, no collr. (7 CAS). Monterey Co.: Del Monte, 20-09-11, F.E. Blaisdell (1 CAS). Marina, 20-09-14, F.E. Blaisdell (2 CAS). Carmel, 14-03-05, no collr. (2 CAS). Tassjara Hot Springs, 3000', 54-05-23, Bryant (1 CAS). Riverside Co.: Palm Canyon, 16-04-15, J.O. Martin (1 CAS). Palm Springs, 17-05-25, J.O. Martin (9 CAS). San Jacinto Mts., no date, F.E. Winters (6 CAS). Riverside, no date, F.E. Winters (3 CAS). San Bernardino Co.: Bear lake, 19-07-10, J.O. Martin (1 CAS). Yermo, 37-04-28, H.B. Leech (1 CAS). San Diego Co.: Poway, no date, F.E. Blaisdell (1 CAS). Julian, 70-06-29, K. Stephan (3 KS). San Luis Obispo Co.: Santa Lucia Range, 2500', 54-06-01, Bryant (1 CAS). San Mateo Co.: Lobitos Cr., 25 mi. S. Half Moon Bay, 64-09-21, H.B. Leech (1 CAS). Santa Barbara Co.: Santa Cruz Island, 70-09-20, P.D. Perkins (1 PDP). Santa Barbara Mts., no date, no collr. (2 MCZ). Siskiyou Co.: Shasta Retreat (now part of Dunsmuir), no date, F.E. Blaisdell (1 CAS). Crawford Creek, 1.7 mi. N. of Cecilleville, 68-07-29, H.B. Leech (2 CAS). Trinity Co.: Big Slide Creek, 5 mi. NW Hyampon, 68-07-24, H.B. Leech (12 CAS). Ventura Co.: Sespe Cr., Sespe Gorge, 3500', 72-06-18, P.D. Perkins (1 PDP). Unspecified Co.: No site, no date, no collr. (1 CAS; 1 ASP). Utah: Garfield Co.: Escalante River, mouth of Calf creek, 39-08-04, H.P. Chandler (1 CAS). Washington Co.: St. George, no date, Wickham (1 MCZ). Zion Nat. Pk., 47-06-26, B. Malkin (1 BMNH). Unspecified Co.: Chad's Ranch, no date, Wickham (3 MCZ; 2 CAS).

51. *Ochthebius martini* Fall

Map: Figure 135C

Specimens examined: 43

United States: California: Humboldt Co.: Redwood Park, 18-08-10, J.O. Martin (1 USNM: 4 MCZ; 12 CAS). Redwood Park, 23-08-09, J.O. Martin (4 CAS). Mill Creek, 7.5 mi. S. of Bridgeville, 1200', 68-07-19, H.B. Leech (7 CAS). No site, no date, no collr. (2 CAS). San Mateo Co.: La Honda Rd., 55-05-22, P.S. Bartholomew (1 CAS). La Honda, 47-05-04, D. Giuliani (2 CAS). Santa Clara Co.: Mt. back of Alma, 29-11-29, J.O. Martin (1 CAS). San Martin, 52-06-26, P.S. Bartholomew (1 CAS). Los Gatos, no date, Hubbard & Schwarz (2 USNM). Los Gatos, no date, no collr. (1 ASP). Santa Cruz Co.: Santa Cruz Mts., no date, A. Koebele (5 USNM).

52. *Ochthebius angularidus* new species

Map: Figure 142A

Paratypes: 26

Mexico: Coahuila: Same data as Holotype (2 HPB; 6 PDP; 6 USNM). Nuevo Leon: Rio Cabisones, near Linares, 64-10-09, H.P. Brown & C.M. Shoemake (2 USNM).

United States: Texas: Pecos Co.: Pecos River, Sheffield, 67-08-25, H.P. Brown (1 USNM). Val Verde Co.: Devil's River, 07-05-07, Schwarz, Pratt & Bishop (5 USNM; 2 PDP). Devil's River, Compton, 72-03-22, H.P. Brown (2 USNM).

53. *Ochthebius leechi* Wood and Perkins

Map: Figure 135C

Specimens examined: 96

United States: California: Colusa Co.: Sulphur Cr. at Wilbur Hot Sprs., flood pool, 56-03-29, H.B. Leech (2 CAS). Sulphur Cr. at Wilbur Springs, 1345', 71-04-05, H.B. Leech (41 CAS; 3 USNM; 3 MCZ; 3 CNC). Wilbur Springs, 1250', 71-06-17, P.D. Perkins (12 USNM). Glenn Co.: Salt Cr. at Stony Cr., N of Stonyford, 56-03-29. H.B. Leech (16 CAS). Trib. to Stony Cr., 7 mi. N. Stonyford, 56-03-29, H.B. Leech (15 CAS). Marin Co.: Sleepy Hollow, Orinda, 38-05-03, H.B. Leech (1 CAS).

1. *Neochthebius vandykei* (Knisch)

Map: Figure 139C

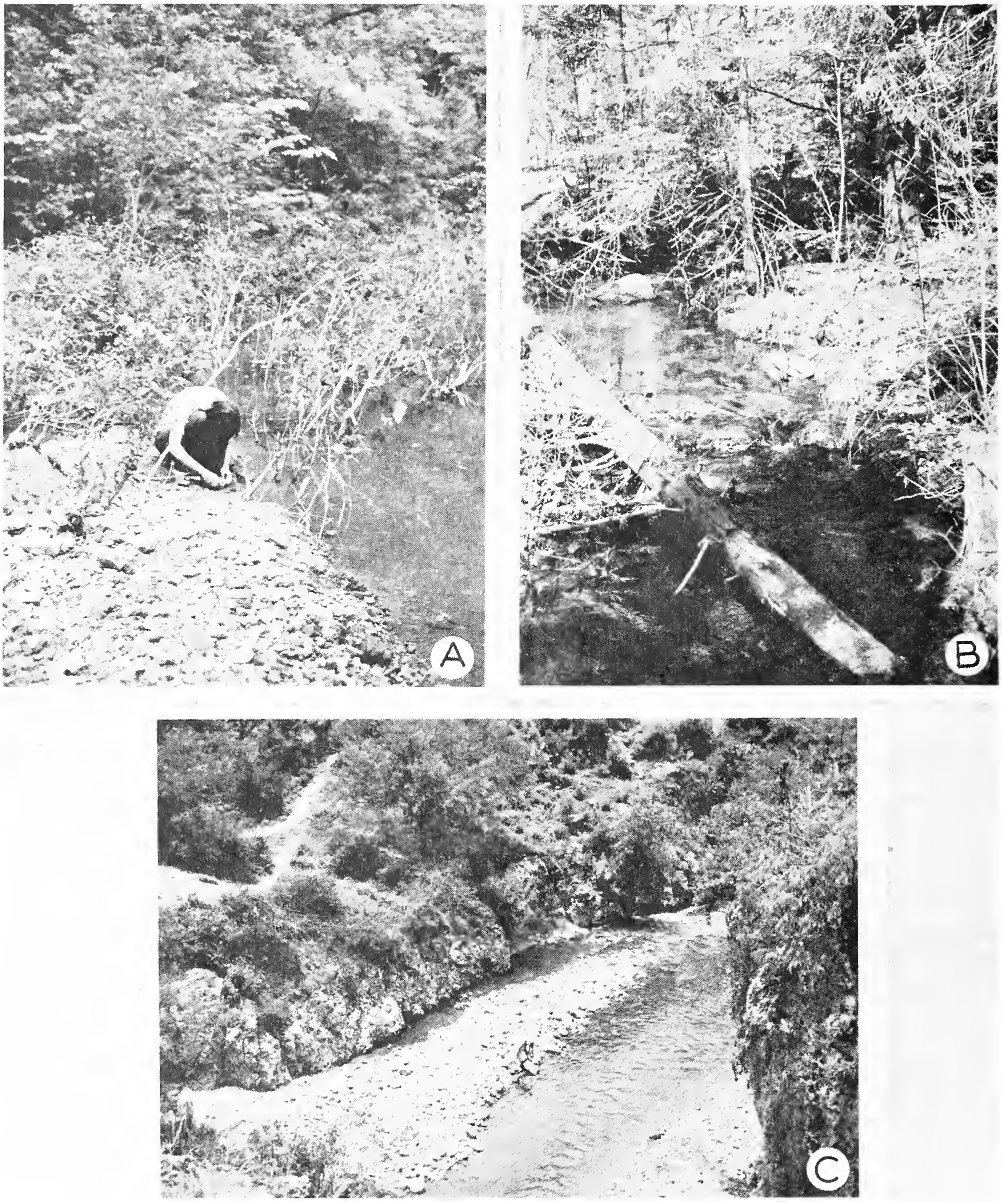
Specimens examined: 257

Canada: British Columbia: Massett, Queen Charlotte Islands, no date, Keene (5 USNM). Metlaktla, no date, Keene (5 USNM). Metlaktla, no date, no collr. (1 MCZ). Brunswick, 68-05-20, Campbell & Smetana (4 CNC). Long Beach, 12 mi. S. Tofino, 68-05-22, Campbell & Smetana (4 CNC).

United States: California: Contra Costa Co.: Jasper Ridge, Stanford Univ., 52-05-31, P.S. Bartholomew (8 CAS). Humboldt Co.: Patrick's Point, 64-07-01, D. Giuliani (2 CAS). Los Angeles Co., Vicente Pt., 64-06-01, D. Giuliani (5 CAS). Marin Co.: Pt. Diablo, 64-07-01, D. Giuliani (2 CAS). Dillon Bch., 64-08-01, D. Giuliani (2 CAS). Strawberry Pt., 64-06-01, D. Giuliani (2 CAS). Agate Beach, 71-03-30, D. Giuliani (4 CAS). Willow Camp, 21-04-10, E.C. Van Dyke (5 CAS). Pt. Reyes, 65-02-01, D. Giuliani (5 CAS). Pt. San Pedro, 65-04-01, D. Giuliani (17 CAS). Needle Rock, 64-10-01, D. Giuliani (3 CAS). Muir Beach, 64-06-01, D. Giuliani (2 CAS). Rocky Point, 64-08-01, D. Giuliani (1 CAS). Gull Rock, 64-08-01, D. Giuliani (1 CAS). Spindrift Point, 64-07-01, D. Giuliani (1 CAS). Mendocino Co.: 1 mi. N.S. Kibesillah 64-08-01, D. Giuliani (2 CAS). Point Arena, 65-06-01, D. Giuliani (3 CAS). 7 mi. N. Havensneck, 65-06-01, D. Giuliani (3 CAS). Monterey Co.: Pacific Grove, 50-10-04, I. Moore (1 CNC). Big Sur, 38-04-01, E.C. Van Dyke (11 CAS). Pt. Pinos, crevices, intertidal rocks, 49-08-25, T. Aarons (6 CAS). San Francisco Co.: Bayview Park, San Francisco Bay, 53-08-23, F.L. Rogers (2 USNM). San Luis Obispo Co.: Pismo Beach, 24-07-31, F.E. Blaisdell (1 MCZ). Shell Beach, 50-10-07, I. Moore (4 CAS; 1 CNC). San Mateo Co.: Moss Beach, many dates between 1910 and 1965, many collectors, including E.C. Van Dyke, F.E. Blaisdell, J.O. Martin, D. Giuliani, and T. Erwin (124 CAS; 6 USNM: 4 OSU; 1 CNC; 1 MCZ). Ano Nuevo Isl., 65-07-01, D. Giuliani (3 CAS). Pillar Pt., 65-06-01, D. Giuliani (6 CAS). Sonoma Co.: Goat Rock, 64-08-01, D. Giuliani (1 CAS). Stewarts Point, 64-08-01, D. Giuliani (1 CAS). Duncan Point, 65-01-01, D. Giuliani (1 CAS). Fort Ross, 27-10-06, E.C. Van Dyke (3 CAS). Bodega Head, 64-08-01, D. Giuliani (2 CAS).

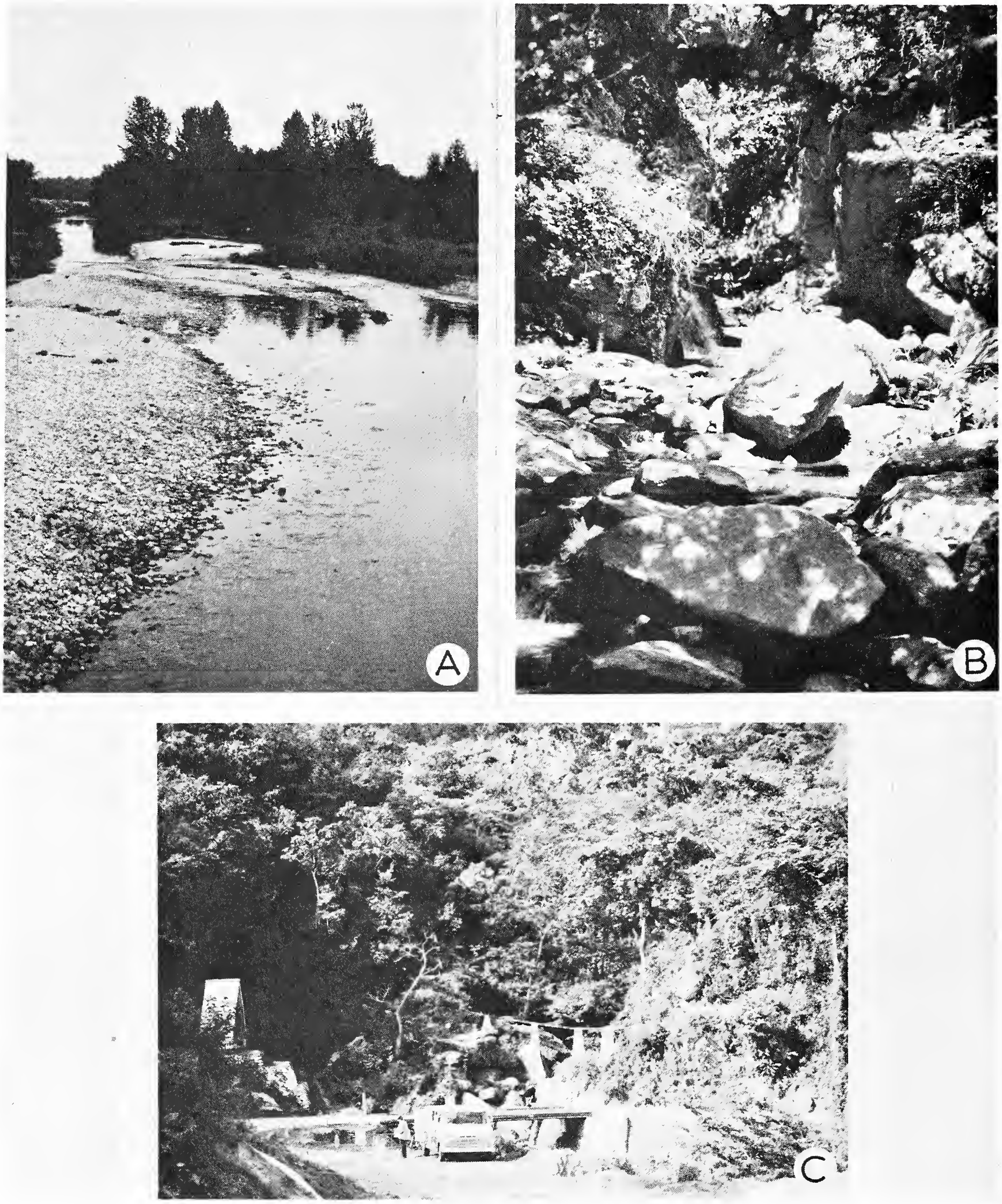
APPENDIX B: TABULAR SUMMARY

	specimens examined	aedeagi examined	species described previously	species described herein	species total
Hydraenida	15	6	1	1	2
Parhydraenida	57	17	4	5	9
Neochthebius	257	6	1	0	1
Meropathus	3	0	0	1	1
Gymnochthebius	1,212	175	11	14	25
Ochthebius	9,794	1,210	23	30	53
Hydraena	7,102	2,722	18	77	95
Spanglerina	288	22	1	3	4
Limnebius	2,522	1,060	5	11	16
	21,250	5,218	64	142	206

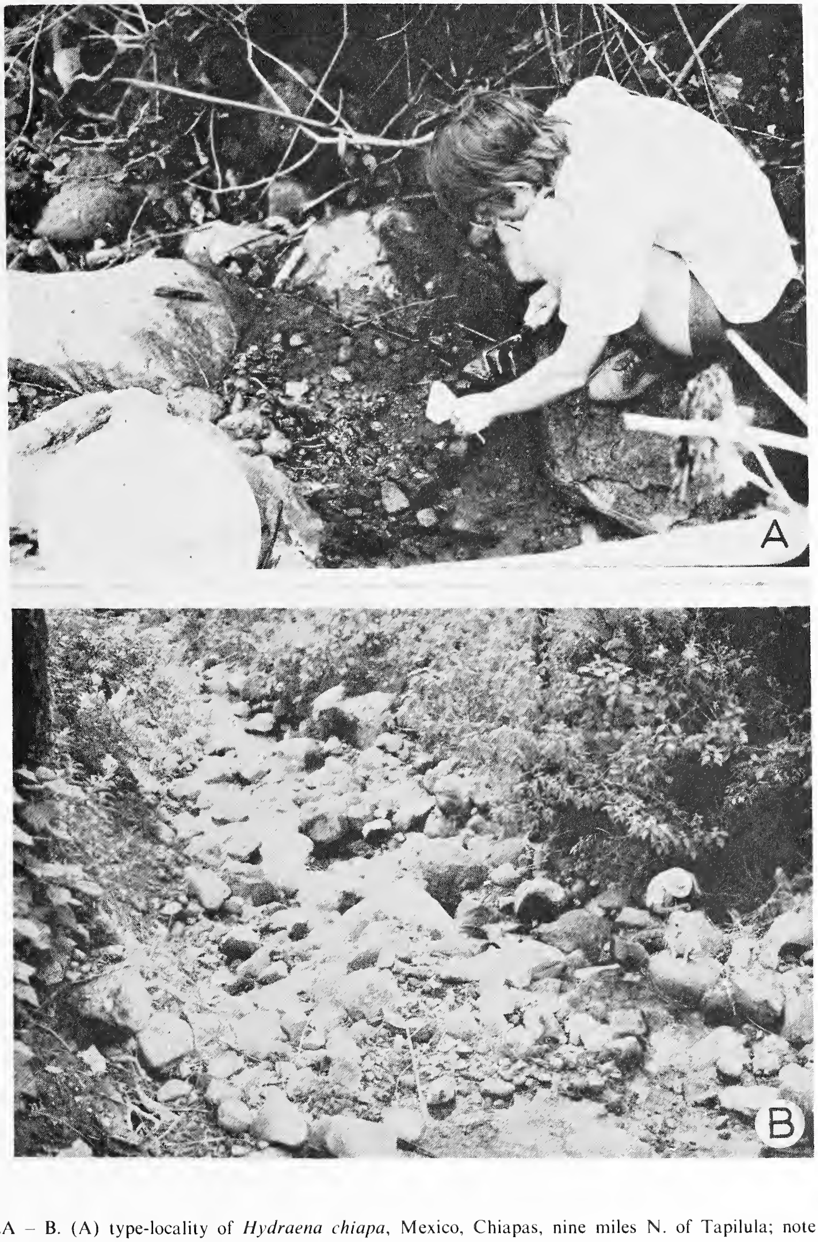


Figs. 189A – C. (A) type-locality of *Hydraena appalachicola*, United States, Virginia, Bath County, two miles south of Mountain Grove, Blowing Springs public camp. (B) biotope of *Hydraena angulicollis*, United States, Maine, Hancock County, Bucksport. (C) type-locality of *Hydraena canticacollis*, Mexico, Zacatecas, thirteen miles south of Jalpa.

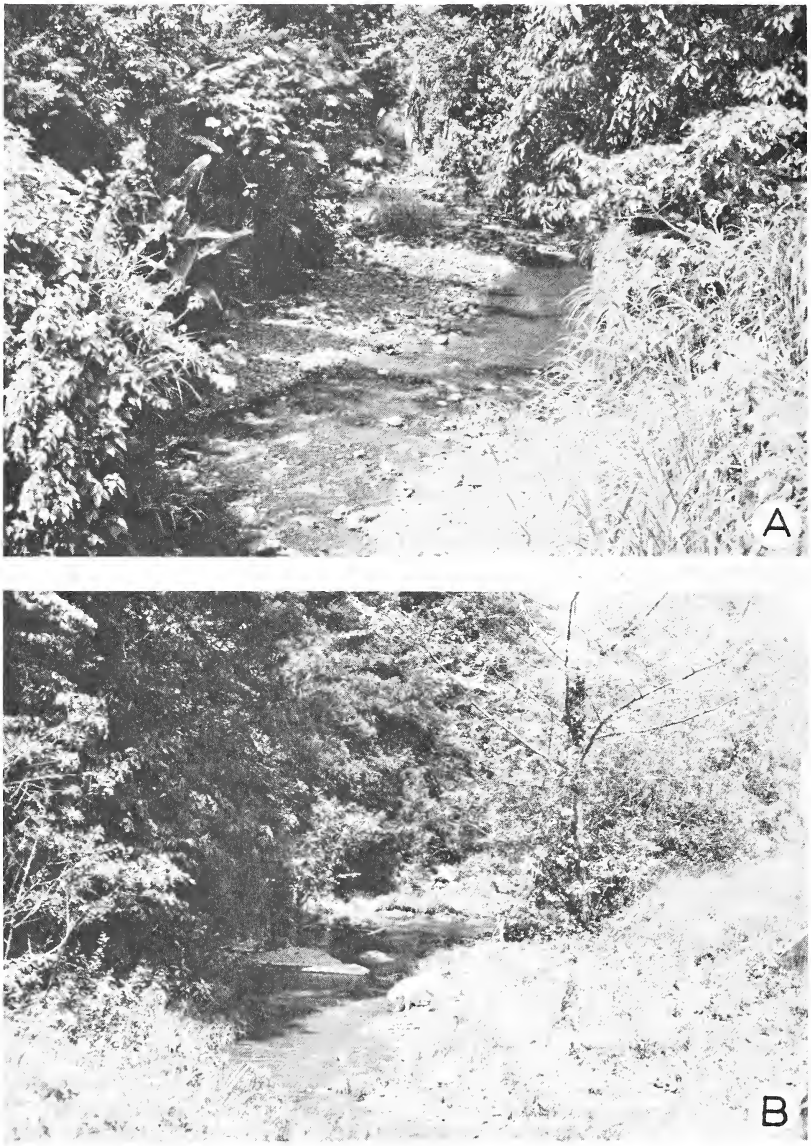
Figs. 190A – B. (A) type-locality of *Hydraena splecoma*, Mexico, Chiapas, four miles N. Bochil. (B) microhabitat at type-locality of *H. splecoma*; area is at base of undercut bank in left portion of figure A.



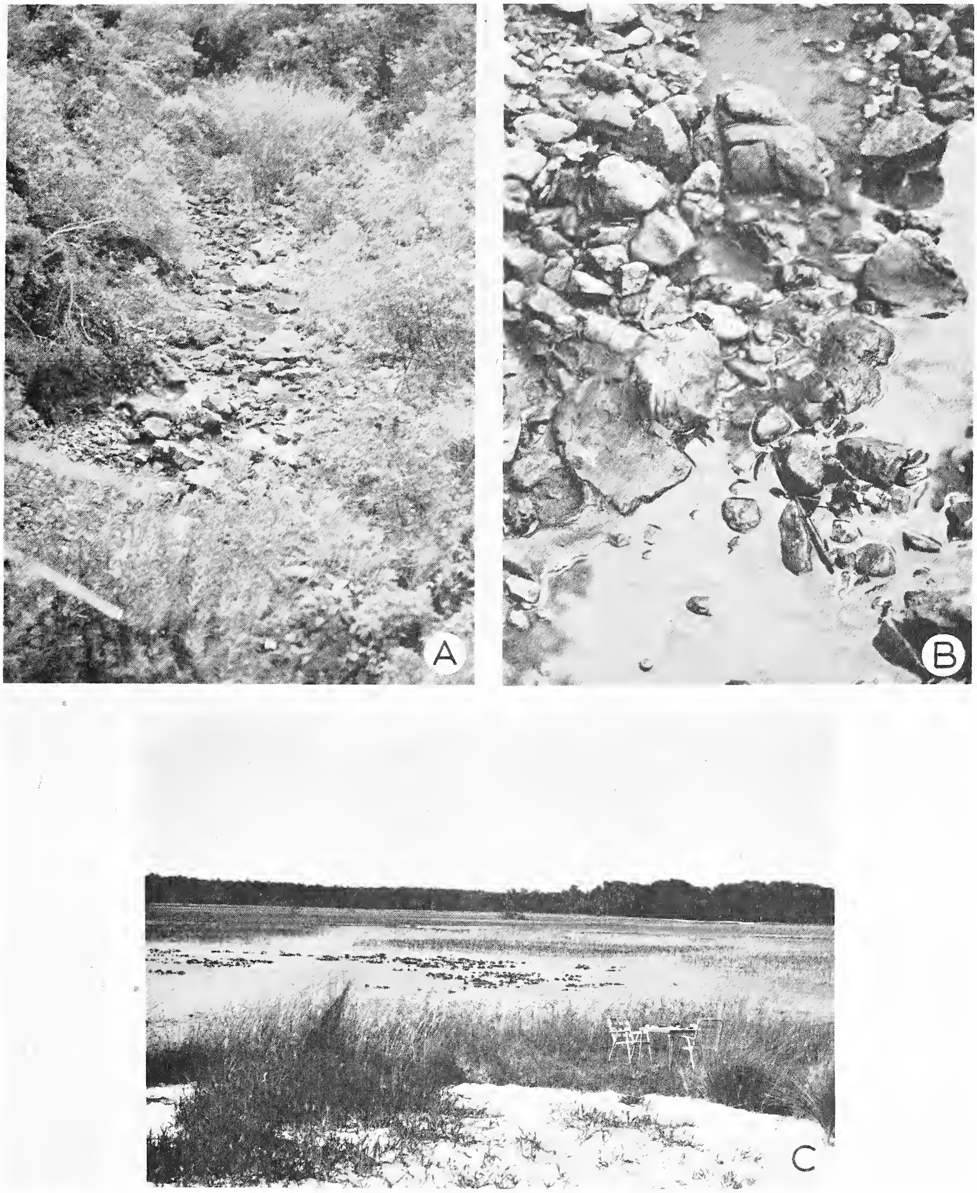
Figs. 191A – C. (A) biotope of *Limnebius alutaceus* and *Ochthebius bisinuatus*, United States, Montana, Ravalli County, Mill Creek at highway 93, seven miles N. of Hamilton. (B) type-locality of *Hydraena oblio*, Guatemala, Baja Verapaz, four miles S. of Rabinal. (C) as above, overview.



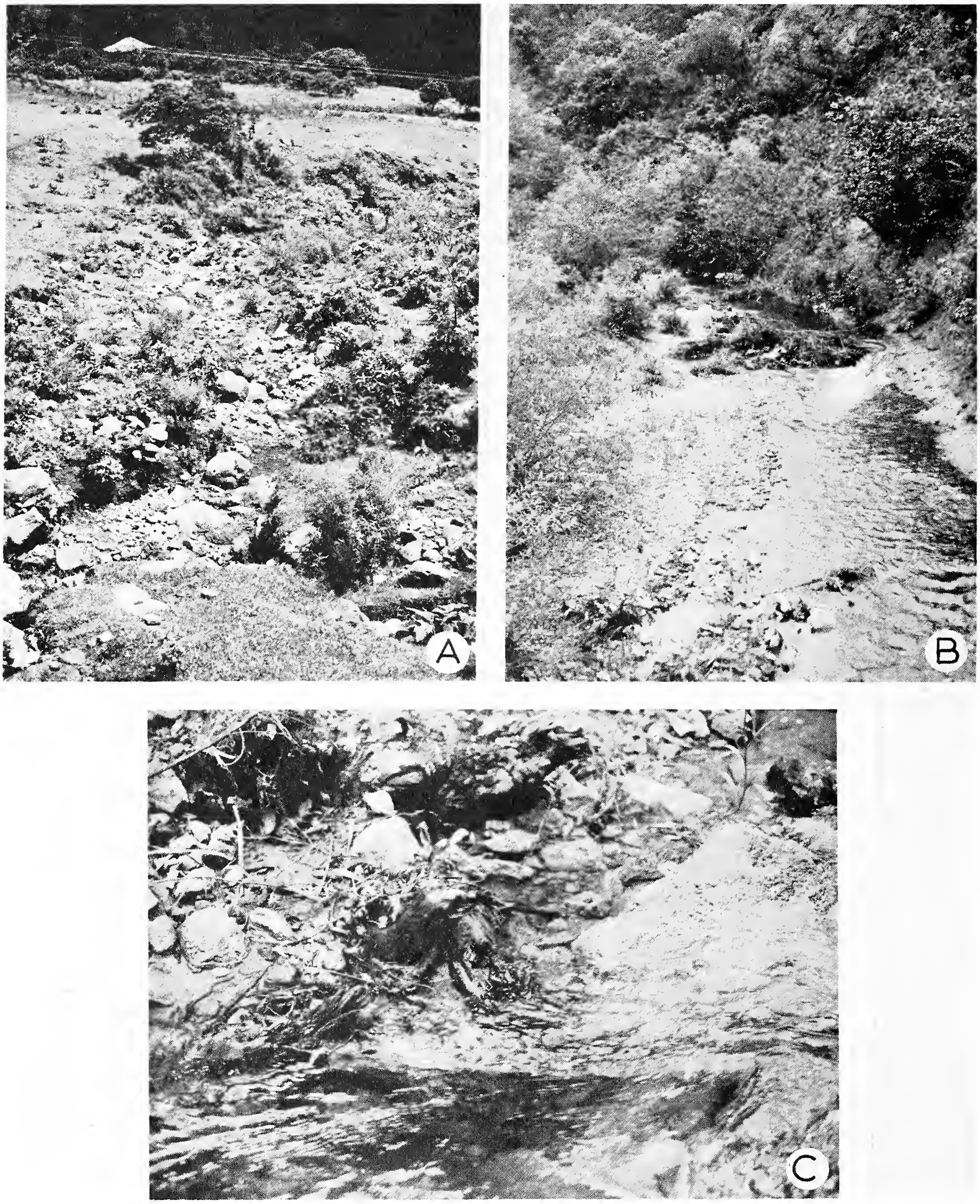
Figs. 192A – B. (A) type-locality of *Hydraena chiapa*, Mexico, Chiapas, nine miles N. of Tapilula; note collecting technique. (B) as above, overview.



Figs. 193A – B. (A) type-locality of *Hydraena sabella*, Mexico, Chiapas, eight miles W. of Teapa; *Gymnochthebius fossatus* also taken at this locality. (B) type-locality of *Hydraena maureenae* and *Limnebius ozapalachicus*, United States, Virginia, Bath County, twelve miles S. of Williamsville.

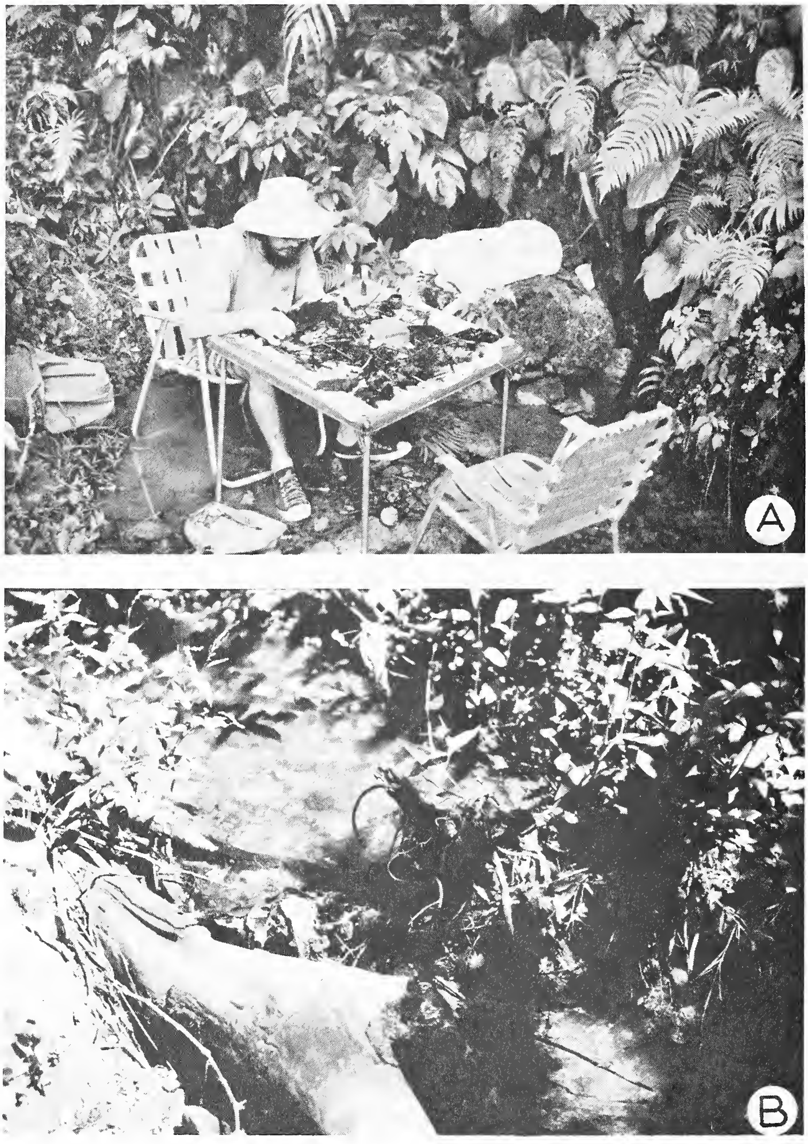


Figs. 194A – C. (A) type-locality of *Hydraena d-destina*, Mexico, Chiapas, 27 miles N. of Comitan; *Ochthebius mesoamericanus* also taken at this site. (B) as above, microhabitat. (C) biotope of *Hydraena marginicollis*, United States, Florida, Alachua County, Payne's Prairie.

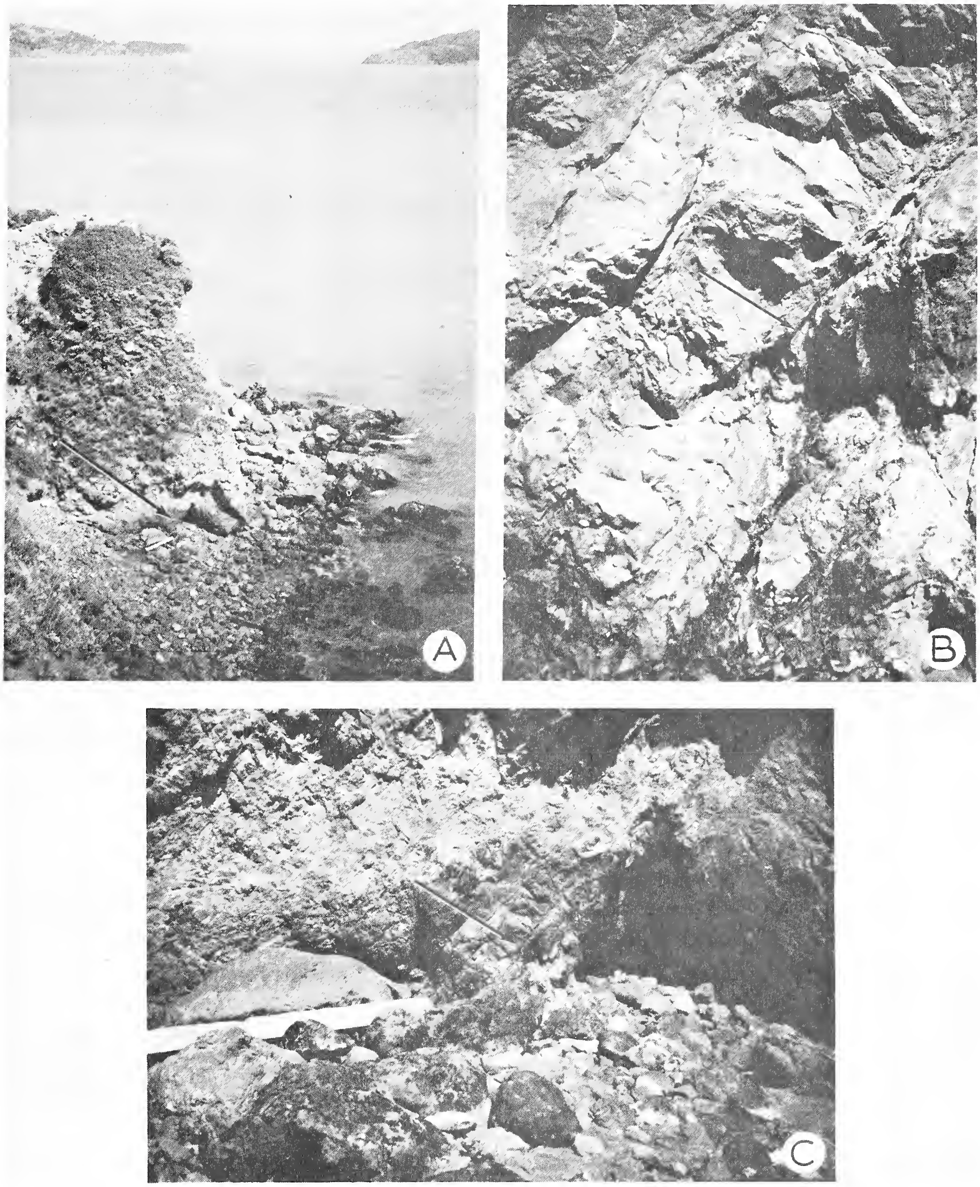


Figs. 195A – C. (A) type-locality of *Hydraena colymba*, Guatemala, Jalapa, six miles N. of Jalapa; specimens of *Limnebius sinuatus* were also found at this site. (B) type-locality of *Spanglerina fluvicola*, *Hydraena cuspidicollis* and *Hydraena scintilla*, Mexico, Oaxaca, one mile N. Ixtlan de Juarez; *Spanglerina brevis* was also collected at this locality. (C) microhabitat of *Spanglerina fluvicola* at type-locality; specimen was removed from submerged limb.

Figs. 196A – C, Biotopes of *Spanglerina brevis*. (A) Guatemala, Alta Verapaz, 20 miles W. of La Tinta. (B) Mexico, Oaxaca, eight miles E. of Tapanatepec. (C) Mexico, Chiapas, nine miles N. of Tapilula.



Figs. 197A – B. (A) biotope of *Spanglerina brevis*, Guatemala, Alta Verapaz, five miles W. La Tinta; note collecting technique, compare with Fig. 192A. (B) microhabitat of *Spanglerina ingens* at type-locality, Mexico, Mexico, 11 miles S. Valle de Bravo.



Figs. 198A – C, Biotope of *Neochthebius vandykei*, Marin Peninsula, Marin County, California. (A) overview; note arrow indicating microhabitat. (B–C) microhabitat; note arrows indicating cracks in rocks from which beetles were collected. (Photographs courtesy of Alan R. Gillogly.)

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SPECIES AND SUBSPECIES

KEYS

Publication of *Quaestiones Entomologicae* was started in 1965 as part of a memorial project for Professor E. H. Strickland, the founder of the Department of Entomology at the University of Alberta in Edmonton in 1922.

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ORIGIN OF TUNDRA BUTTERFLIES IN ALBERTA

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ABSTRACT

Four distribution types are recognized in the tundra butterfly fauna of Alberta. These indicate two source areas. The major source area was south of Wisconsin ice in northern Washington, Idaho, and Montana. Nine taxa survived in this unglaciated area, five with a Southern Montane distribution: Lycaena phlaeas arethusa *(Wolley-Dod 1907),* Lycaena snowi snowi *(Edwards, 1881),* Oeneis polixenes brucei *(Edwards, 1891),* Oeneis bore edwardsi *dos Passos, 1949, and* Oeneis melissa beani *Elwes, 1893. The remaining four have a Central Montane distribution:* Colias nastes streckeri *Grim-Grschimaillo, 1895,* Boloria astarte *(Doubleday, 1846-1852(1847)),* Boloria alberta *(Edwards,Edwards 1890)* Euphydryas editha beani *Skinner, 1897. This refugium was restricted on the north by the presence of ice, and on the other three sides by lack of suitable habitat, indicating a narrow and discontinuous tundra belt south of Wisconsin ice. With retreat of Wisconsin ice, dispersal north was stopped by the elimination of continuous tundra in mountain valleys.*

Taxa with disjunct populations or endemic forms survived glaciations in an Albertan refugium in the vicinity of Mountain Park. The Albertan refugium did not contribute significantly to the colonization of present day Alberta tundra. Disjunct distribution is shown by Boloria improba youngi *(Holland, 1900). Endemic forms are* Boloria eunomia nichollae *(Barnes and Benjamin, 1926),* Boloria napaea reiffi *Reuss, 1925, and an ecological form of* Oeneis melissa beani *Elwes, 1893.*

This investigation yielded information on two isolated refugia. Therefore, the study of butterfly distribution patterns is deemed of great potential value in the study of Wisconsin glacial refugia in general.

On reconnaît quatre types de distribution parmi la faune albertaine des papillons diurnes de la toundra. Ces types indiquent qu'il existe deux régions d'origine pour ces papillons. La principale est située sud de la calotte glaciaire du Wisconsin dans le nord des états de Washington, de l'Idaho et du Montana. Dans cette région, qui échappa à la glaciation, neuf taxons ont survécu, dont cinq sont distribués dans l'étage montagnard sud; ce sont: Lycaena phlaeas arethusa *(Wolley-Dod, 1907),* Lycaena snowi snowi *(Edwards, 1881),* Oeneis polixenes brucei *(Edwards, 1891),* Oeneis bore edwardsi *dos Passos, 1949, et* Oeneis melissa beani *Elwes, 1893. Les quatre autres taxons occupent l'étage montagnard central; ce sont:* Colias nastes streckeri *Grum-Grschimaillo, 1895,* Boloria astarte *(Doubleday 1846-1852 (1847)),* Boloria alberta *(Edwards, 1890) et* Euphydryas editha beani *Skinner, 1897. Cette zone refuge était limitée au nord par la calotte glaciaire, et sur ses trois autres côtés, par l'absence d'habitats propices, indiquant que la ceinture de toundra était étroite et discontinue au sud de la calotte glaciaire du Wisconsin. Avec le retrait de la calotte, la dispersion vers le nord fut interrompue par l'élimination des zones continues de toundra dans les vallées de montagne.*

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Des taxons à populations disjointes ou des formes endémiques ont survécu aux glaciations dans un refuge albertain situé près de Mountain Park. Ce refuge ne contribua pas de facon significative à la colonisation de la toundra albertaine actuelle. Une distribution disjointe apparaît chez Boloria improba youngi *(Holland, 1900). Les formes endémiques sont représentées par* Boloria eunomia nichollae *(Barnes et Benjamin, 1926),* Boloria napaea reiffi *Reuss, 1925, et par une variété éologique d'*Oeneis melissa beani *Elwes, 1893.*

Cette recherche fournit de l'information sur deux refuges isolés. Par conséquent, l'etude des patrons de distribution des papillons est considérée comme ayant une grande valeur potentielle dans l'étude des refuges de la période glaciaire Wisconsin.

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INTRODUCTION

Certain butterfly taxa have long been recognized as having relict distributions which reflect Pleistocene events (Grote, 1875; Maynard, 1886; Holland, 1898). In spite of the early recognition of these relict taxa, few subsequent workers have considered butterflies in studies of suspected refugia in North America.

Yet butterflies would seem to be subjects well suited to such studies for two reasons. In terms of numbers of species, butterflies form an important part of the tundra community. There are more species of butterflies on the arctic islands than there are of the order Coleoptera (Ryan, 1977). This indicates a high probability that they might survive the conditions of a tundra refugium. A second reason is that butterflies appear to differentiate more rapidly than many other insect taxa (Ford, 1946). This suggests that butterfly taxa surviving in a small refugium might develop endemic tendencies to a greater extent than other insects.

A number of tundra refugia of this type have been suggested in North America, but few have escaped criticism. One that has, is in the area of Mountain Park, Alberta, Canada (see figure 1). This area is easily accessable and so became the focal area of this study.

The objectives of this paper were to determine the value of the distributions of Alberta s tundra butterflies to the study of Wisconsin age refugia. This entails the location of source areas, routes of immigration, and barriers to dispersal. In order to meet this objective, detailed distribution maps of all North American were compiled.

MATERIALS AND METHODS

Materials

During the course of this study, 1124 specimens were collected in Alberta and British Columbia, of which 907 represent taxa known to occur in Alberta. A further 720 specimens were examined from private collections, making a total of 1844 specimens.

Specimens collected within the boundaries of Banff and Jasper National Parks are deposited in the Canadian National Collection, Ottawa, Ontario; University of Alberta Strickland Museum, Edmonton, Alberta; and Park offices in Banff and Jasper. Remaining specimens are deposited as follows: voucher specimens to the University of Alberta Strickland Museum, and selected series to my collection. Some material was exchanged for specimens for future research.

Methods

A tundra butterfly species is a taxon in which the life cycle is confined to areas above treeline. This definition includes both arctic and alpine taxa. The existence of tundra is usually defined through reference to treeline. Treeline is here used to delineate the lower, or southern, boundary of the subarctic or subalpine zone as defined by Löve (1970). This is necessitated by the occurence of tundra butterfly taxa south of the actual limit of trees.

Because of limited dispersal abilities of most species used as ndicators of refugia, and the island nature of alpine tundra, taxa restricted to tundra provide the best biological evidence for identifying sites of suspected alpine refugia.

Because this study is not a revision, subspecies were accepted as presented in dos Passos (1964), as modified by more recently published information. None of these subspecies has been adequately investigated. Although many may not be valid taxonomically, the names provide convenient sources of reference to recognizably distinct populations. This is the sole reason for their use in this study. Most subspecies of in Alberta are fairly distinct, and are readily placed with populations outside the province. This allows reasonably secure hypotheses about their evolution and dispersal into Alberta.

Study area

The area under study includes all known tundra examined for butterflies in North America, but the focus of attention is on tundra in Alberta. Tundra extends from the Sierra Nevada of California and the Sangre de Cristo range of New Mexico (approximately 36° N.) at elevations of over 3384 meters (11,000 ft.), north to the limit of land on Ellesmere Island and Greenland (approximately 83° N.). In eastern North America, isolated areas of tundra occur as far south as Mount Marcy, New York, and Mount Washington, New Hampshire (approximately 44° N.) at elevations of just over 1358 meters (5000 ft.).

In Alberta, tundra extends from the United States border (49° N.) north to about 56° 20 N., where the Rocky Mountains are extended west of the provincial boundary. province. Occurrence of tundra roughly parallels the Alberta-British Columbia border along the continental divide. It is usually above 1970 meters (6500 ft.) in northern areas of the province, gradually increasing in elevation to the point where it is not found below 2153 meters (7000 ft.) at 49° N.

Results

The following tundra butterfly taxa have been reported from North America.

Where possible, sequence and classification follow dos Passos (1964). Numbers preceding names refer to this ordering. Changes reflect recent descriptions or instances where status of taxa have been questioned. Asterisks preceding a name indicates that the taxon has been recorded from Alberta.

243 *Parnassiius eversmanni thor* H. Edwards, 1881

Type-locality; upper reaches of the Yukon River.

Geographical Distribution. – Known distribution is given in Figure 2. This species is also recorded from arctic Europe and Asia, southward on numerous mountain ranges, with one disjunct population in Japan. In North America, this subspecies has dispersed outside of Beringia only to adjacent mountain ranges in British Columbia, where it is represented by two populations whose ranges are disjunct from one another.

Material examined: 88 specimens.

285 *Colias boothii* Curtis, 1835

Type-locality: Boothia peninsula, North West Territories.

Notes. –

Adults of this species have been confused by taxonomists in the past with those of *C. nastes* and *C. hecla,* and the species was once thought to represent a hybrid of these taxa. It is now recognized as a distinct species, but some taxonomists still confuse specimens with those of yellow populations of *C. nastes* , particularly *C. n. thula* (Philip, in The Lepidopterists' Society season Summaries, 1974, 1975, 1976). Populations of *C. n. thula* are sympatric with those of *C. n. aliaska*. This indicates three possibilities: *C. n. thula* is a spcies distinct from both *C. boothii* and *C. nastes; C. n. thula* is an Alaskan subspecies of *C. boothii*; *C. n. thula* is a form of *C. nastes* not deserving taxonomic recognition. Because neither *C. n. thula* or *C. boothii* are found in Alberta, this problem does not affect the outcome of this project.

Geographical Distribution. –

Distribution is indicated in Figure 3, along with that of *C. n. thula* which is plotted here to show that the two are allopatric. *C. n. thula* is restricted to northern Alaska, *C. boothii* to the North West Territories and the Yukon Territory.

Material examined: 2 specimens.

296 *Colias nastes* Boisduval, 1832

Seven subspecies are currently recognized.

C. n. nastes Boisduval, 1932

Type-locality: Labrador (Ungava Peninsula).

C. n. rossi Guenee, 1864

Type-locality: Boothia Peninsula, North West Territories.

C. n. moina Strecker, 1880

Type-locality: Churchill, Manitoba.

* *C. n. streckeri* Grum-Grschimailo, 1895

Type-locality: Laggan, Alberta (Lake Louise).

C. n. cocandicides Verity, 1911

Type-locality: unavailable.

C. n. thula Hovanitz,
Type-locality: Meade River, Alaska.
C. n. aliaska Bang-Haas, 1927
Type-locality: unavailable

Notes. –

C. n. streckeri includes only green colormorphs, which exhibit slight, but constant variation. Adults were first collected on a number of mountains in the vicinity of Laggan, Alberta, by T. E. Bean. It has since been reported from many mountains in Alberta. Colonies probably exist in the province wherever tundra has developed. Specimens are usually abundant, although often difficult to catch. Populations from Pink Mountain, British Columbia, are provisionally assigned to this subspecies.

This species has not been adequately treated in a revision. If it were, it is probable that some of the presently accepted names would be synonymized.

Geographical Distribution. –

Distribution is shown in Figures 3 and 4. This species is also known from Europe and Asia. In North America, it is recorded from Alaska, Yukon and North West Territories, Quebec, Manitoba, Labrador, British Columbia, Alberta, Washington, and Montana. Alberta distribution is indicated in Figure 24.

Exact limits of the subspecies are not known in the arctic, although the range shown on the map is probably close to the actual range of the species.

Material examined: 271 specimens.

443 *Lycaena phleas* Linnaeus(Linnaeus, 1761)
Four subspecies are recognized, only three of which are restricted to tundra habitat.
L. p. hypophleas Boisduval, 1852)
Type-locality: Sierra of California.
**L. p. arethusa* (Wolley-Dod, 1907)
Type-locality: Sheep River, 30 miles south west of Calgary, Alberta.
L. p. feildeni (M'Lachlan, 1878)
Type-locality: Ellesmere Island, 81° 41   N., North West Territories.

Notes. –

The distribution patterns and relationships between the various subspecies in Europe and North America are poorly understood. In North America, one subspecies, *L.p. americanaLycaena phleas americana*, does not occur on tundra. Also, while *L. p. arethusa* specimens are encountered most often above treeline, some range well below treeline in Alberta. The type locality, if taken literally, is well below treeline, although Wolley-Dod may have been referring to the headwaters of the River, which are much higher in elevation. Specimens have been taken below treeline more regularly at Mountain Park, and northwards on Prospect Mountain, and at Moberly Creek, and Grande Cache. In spite of intensive collecting in recent years, specimens have not been found below treeline south of Mountain Park. For this reason, boreo-montane populations are here considered to be derived from alpine populations, and this subspecies is considered a tundra butterfly. It is also possible that the low altitude populations represent a distinct taxon separate from the alpine populations.

Geographical Distribution. –

L. p. arethusa is found as far south as Colorado, and as far north as Grande Cache, Alberta. The nominotypical form is European. This species is found over much of Europe and Asia. The

Nearctic distribution is indicated in Figure 5. Alberta distribution is indicated in Figure 25.
Material examined: 33 specimens.

445 *Lyceana snowi* (Edwards, 1881)
Two subspecies are recognized.
* *L. s. snowi* (Edwards, 1881)
Type-locality: Colorado.
L. s. henryae (Cadbury, 1937)
Type-locality: Cariboo Pass, Peace River Country, British Columbia.
Notes. –

L. s. henryae has not been collected since its description. *L. s. snowi* was first collected in Alberta by T. E. Bean in the vicinity of Laggan. However, specimens are more commonly encountered to the south than to the north in the province. In Alberta, it appears to be restricted to above treeline, but in Wyoming, it has been reported below treeline (Howe, 1975; Ferris, 1971).

Opinions differ about the relationship of this species to *L. cupreus*, whose range is below treeline in California, north east to Colorado. Howe (1975) and Ehrlich and Ehrlich (1961) consider the two groups conspecific. Dos Passos and most previous authors consider them distinct. I follow dos Passos. Certainly the two taxa are closely related. However, this taxonomic problem does not affect the outcome of this project because the Alberta material is clearly similar to *L. snowi* of Colorado.

Geographical Distribution. –

Distribution is indicated in Figure 6. *L. snowi* is found from Colorado north to central British Columbia. It has not been reported from the Yukon Territory or Alaska. Alberta distribution is indicated in Figure 26.

Material examined: 25 specimens.

595 *Euphydryas editha* (Boisduval, 1852)
Eighteen subspecies are currently recognized. Of these, only four are restricted to tundra. These are treated below.
E. e. nubigena Behr, 1863
Type-locality: Headwaters of the Tuolumne River and beyond to elevations of 11500 ft. (3538 m.), California.
E. e. lawrenci Gunder, 1931
Type-locality: Mount Theilsen, Douglas County, Oregon.
E. e. colonia Write, 1905
Type-locality: Mt. Hood, Oregon.
**E. e. beani* Skinner, 1897
Type-locality: High elevations near Laggan, Alberta (Lake Louise).
Notes. –

While most subspecies of *E. editha* are not found on tundra, these four subspecies appear to be restricted to tundra environments, which they evidently colonized recently, apparently in response to empty niches on the mountains they inhabit. With the exception of *E. e. beani*, they occur where there are virtually no other tundra butterflies.

E. e. beani has been reported more commonly to the south of the type locality, where specimens were collected by T. E. Bean. Specimens are easily confused with alpine specimens

of *E. anicia*. The northern records of *E. e. beani* are older, and may represent misidentifications, but most of the southern records have been verified in recent years.

Geographical Distribution. –

Distributions are indicated in Figure 7. *E. e. beani* is restricted to the mountains of southern Alberta and British Columbia and *E. e. nubigena* is restricted to the high Sierras of California. The other two subspecies have only been recorded from their type localities. Alberta distribution is indicated in Figure 27.

Material examined: 27 specimens.

597 *Boloria napaca* (Hoffmansegg, 1804)

The nominotypical form is European. Four subspecies have been recorded from North America.

B. n. alaskensis (Holland, 1900)

Type-locality: Mountains between 40 mile and Mission Creeks, Alaska.

B. n. nearctica Verity, 1932

Type-locality: North eastern Alaska.

**B. n. reiffi* Reuss, 1925

Type locality: Mountains of British Columbia.

B. n. halli Klots, 1940

Type-locality: Green River Pass, Wind River Mountains, Wyoming.

Notes. –

Shepard (in Howe, 1975) has made *B. n. reiffi* a junior synonym of *B. n. alaskensis* . This is without warrant, for it is not based on study of the type specimen, but rather on conjecture by Klots (1940) and Warren (1944). Specimens of *B. n. reiffi* have been recorded from Kvass Creek Summit and the headwaters of the Berland River, Alberta. I adopt this assignment because of the proximity of the type locality.

In the past, these subspecies were treated under the name *B. pales* (Denis and Schiffermuller, 1775). Warren(1944) placed them under the name *B. napaea.* This is generally accepted, but it is based on characters of doubtful significance.

Geographical Distribution. –

Distribution is indicated in Figure 8. This species is common in arctic and alpine areas of Europe and Asia. In North America, it is found in Alaska, Yukon Territory, and arctic North West Territories excluding the northern-most arctic islands. It has been reported in northern British Columbia, and as disjunct populations in central Alberta, and in Wyoming. Alberta distribution is indicated in Figure 28.

Material examined: 78 specimens.

601 *Boloria improba (Butler, 1877)*

Two subspecies are recognized.

B. i. improba (Butler, 1877)

Type-locality: Winter Cove, Cambridge Bay, North West Territories.

**B. i. youngi* (Holland, 1900)

Type-locality: Mountains between 40 mile and Mission Creeks, Alaska.

Notes. –

B. improba was first reported from Alberta in 1976 from Prospect Mountain (see Figure 1). Eleven specimens have been collected. Adults of this population appear most similar to those of

B. i. youngi, and the Alberta population is so placed, but it may deserve subspecific status. Adults show constant and remarkably stable differences from adults of other examined populations. This is a highly variable species year to year, so longer series are needed before a decision can be made. In the summer of 1978, another disjunct population was discovered in Colorado (Sperling, pers. comm.)
This population has been described as *B. acrocnema* Gall and Sperling, 1980.

Geographical Distribution. –

Distributions of the two subspecies are indicated in Figure 9. This species is also known from arctic Europe and Asia. In North America, it is found in Alaska, the Yukon Territory, arctic North West Territories excluding the high arctic islands, northern British Columbia, and disjunct populations in west-central Alberta and Colorado. Alberta distribution is indicated in Figure 29.

Material examined 147 specimens.

604 *Boloria polaris* (Boisduval, 1829)
Three subspecies are recognized.
B. p. polaris (Boisduval, 1829)
Type-locality: Norwegian Alps.
B. p. groenlandica (Skinner, 1892)
Type-locality: Greenland.
B p. stellata Masters, 1972
Type-locality: Churchill, Manitoba.

Notes. –

Adults of this species are rarely collected, although they are often abundant. Unlike most butterfly species, very few infraspecific names have been proposed for this taxon.

Geographical Distribution. –

This species is found from Lappland across arctic Europe and Asia to Greenland. In North America, it is recorded from Alaska, Yukon Territory, North West Territories including the high arctic islands, Manitoba, Quebec, Labrador, and northern British Columbia. Distribution is indicated in Figure 10.

Material examined: 234 specimens.

606 **Boloria alberta* (Edwards, 1890)
Type-locality: Laggan, Alberta (Lake Louise).

Notes. –

This species has been reported from Anaktuvuk Pass, Alaska, but because worn adults of *B. polaris* and *B. distincta* resemble those of *B. alberta*, this record must be regarded as suspect.

Geographical Distribution. –

This species is restricted to high alpine areas in northern Montana, southern Alberta and British Columbia. A different subspecies has been reported from the U.S.S.R. Nearctic distribution is indicated in Figure 12. Alberta distribution is indicated in Figure 30.

Material examined: 43 specimens.

607 **Boloria astarte* (Doubleday, 1846-1852(1847))
Type-locality: Mountains of British Columbia, here restricted to Mt. Cheam.

Notes. –

dos Passos (1964) and Shepard (in Howe, 1975) recognize two subspecies; *B. a. astarte* and *B. a. distincta*. Wyatt (1957) discounts the hypothesis that they are conspecific. Because of numerous differences between the two taxa, I follow Wyatt. Certainly they are easily separated, but closely related. The problem does not affect the outcome of this project.

Type-locality is the mountains of British Columbia. (Edwards 1891) roposed the name which he later recognized as a junior synonym of *B. astarte*. The type locality for *A. victoria* is Laggan, Alberta (Lake Louise).

At the time of the description of *B. astarte*, British Columbia s boundaries were poorly defined or non-existent, and the area around Laggan was unexplored. It seems reasonable to restrict the type locality of *B. astarte* to the locality nearest the major cities of British Columbia around 1800-1820. The type-locality is hereby restricted to Mount Cheam, south of Hope, British Columbia, where lives the population closes to Vancouver Island and the mouth of the Frazer River.

Geographical Distribution. –

Distribution is indicated in Figure 12. This species is recorded from British Columbia, Alberta, and northern Washington and Montana. Alberta distribution is indicated in Figure 34.

Material examined: 60 specimens.

607b *Boloria distincta* (Gibson, 1920)

Type-locality: Harrington Creek, Yukon Territory.

Geographical Distribution. –

In North America this species appears to be restricted to Beringia with one record from Atlin, British Columbia and a few from the Richardson Mountains, North West Territories. Distribution is indicated in Figure 13.

Material examined: 15 specimens.

610 *Boloria eunomia* (Esper, 1787)

Seven subspecies are recognized in North America, four of which are restricted to tundra (includes alpine bogs) conditions above treeline.

B. e. caelestis (Hemming, 1933)

Type-locality: Hall Valley, Park County, Colorado.

B. e. ursadentis Ferris and Groothuis, 1971

Type-locality: Beartooth Plateau, Wyoming.

**B. e. nichollae* (Barnes and Benjamin, 1926)

Type-locality: Rocky Mountains of North America, here restricted to the north end of Wilcox Pass, Columbia ice fields, Jasper National Park, Alberta.

B. e. laddi (Klots, 1940)

Type-locality: Lewis Lake, Albany County, Wyoming.

Notes. –

B. e. nichollae was misidentified by Shepard (in Howe, 1975). His identification was based on the fact that according to the published itinerary of the original collector s trip west (Nicholls, 1905), she did not and could not have collected in the area where a dark form corresponding to the description is found. However, she made a later trip west, as indicated by records of *B. alberta* and *B. astarte* collected by her at the headwaters of the Saskatchewan and Athabasca Rivers, Alberta (Entomological Society of Ontario, records; seasonal collection list,

1907). This area is the center of the distribution of the dark form of *B. eunomia*. This suggests that Mrs. Nicholls could have collected the type series during her second trip. This is supported by a paratype from the USNM which is darker than normal adults from most areas in the mountains of Alberta. Accordingly, the type locality is restricted to the north end of Wilcox pass, Columbia Ice Fields, Jasper National Park, Alberta. This pass was chosen because before the highway was built between Jasper and Lake Louise, the only way to cross from the Athabasca watershed to that of the Saskatchewan River was via this pass by pack train (J. Pike, pers. comm.). If Mrs. Nicholls collected in both watersheds, she must have used this pass, and probably collected there as evidenced by the type series of *B. e. nichollae.*

Geographical Distribution. –

Distributions of the four subspecies are indicated in Figure 14. *B. e. nichollae* is restricted to west-central Alberta, *B. e. ursadentis* to its type-locality (Beartooth Plateau, Wyoming), *B. e. laddi* to Wyoming, and *B. e. caelestis* to Colorado. There has been one record of *B. e. laddi* from Colorado, but this has been questioned. Alberta distribution is indicated in Figure 32.

Material examined: 184 specimens.

667 *Oeneis bore* (Schneider, 1792)

Included here is *O. taygete* Geyer, 1830. Six subspecies are recognized.

O. b. taygete Geyer, 1830

Type-locality: Hopedale, Labrador.

O. b. gaspeensis dos Passos, 1949

Type-locality: Mount Albert, Quebec.

O. b. fordi dos Passos, 1949

Type-locality: Kuskoquim River Valley, Alaska.

**O. b. edwardsi* dos Passos, 1949

Type-locality: San Juan Mountains, Hinsdale County, Colorado.

O. b. hanburyi Watkins, 1928 .

Type-locality: Coronation Gulf, North West Territories.

O. b. mackinleyensis dos Passos, 1949

Type-locality: Mount McKinley National Park, Alaska.

Notes. –

Adults of these subspecies are very similar to one another. Alberta material was ascribed to *O. b. edwardsi* by dos Passos in his description. Adults were first collected in the province at Nordegg by K. Bowman.

Adults of what is usually considered *O. taygete* are distinguished by the presence of white outlined veins on the ventral hind wings. This character does not appear to be constant. Because of this, and the amount of confusion surrounding the use of these names in the literature, they are here treated as synonyms to facilitate the handling of locality data. Either way, the outcome of this project is not affected.

Geographical Distribution. –

Distribution is indicated in Figure 15. This species is found in Alaska, Yukon Territory, arctic North West Territories excluding the high arctic islands, Quebec, Manitoba, Labrador, northern British Columbia, Alberta, Montana, Wyoming, and Colorado. There is one record from Utah. It is also known from Europe and Asia, along the coast of the Arctic Ocean. Alberta distribution is indicated in Figure 32.

Material examined: 178 specimens.

670 *Oeneis melissa* (Fabricius, 1775)
Seven subspecies are recognized.
O. m. melissa (Fabricius, 1775)
Type-locality: Newfoundland.
O. m. semplei Holland, 1931
Type-locality: Little Cape James River; Churchill, Manitoba; Hudson Bay.
O. m. assimilis Butler, 1868
Type-locality: Repulse Bay, North West Territories.
O. m. gibsoni Holland, 1931
Type-locality: Kuskoquim River Valley, Alaska.
O. m. lucilla Barnes and McDunnogh, 1918
Type-locality: Hall Valley, Colorado.
**O. m. beani* Elwes, 1893
Type-locality: Laggan, Alberta (Lake Louise).
O. m. semidea (Say, 1828)
Type-locality: White Mountains, New Hampshire.

Notes. –

North of the type-locality, specimens of *O. m. beani*, while appearing phenotypically identical to southern specimens, live in a different habitat. Southern populations are restricted to areas of rock covered by black lichens. In the north, they are found on stable talus slopes where there is no black lichen.

Distributions of the seven subspecies are indicated in Figure 16. Geographical limits of the arctic subspecies are uncertain. This species is recorded from Alaska, the Yukon Territory, arctic North West Territories excluding the high arctic islands, Quebec, Manitoba, Labrador, Newfoundland, British Columbia, Alberta, Montana, Wyoming, Utah, Colorado, New Mexico, and New Hampshire. Alberta distribution is indicated in Figure 34.

Material examined: 99 specimens.

671 *Oeneis polixenes* (Fabricius, 1775)
Six subspecies are recognized.
O. p. polixenes (Fabricius, 1775)
Type-locality: Labrador? America Boreali
O. p. subhyalina (Curtis, 1835)
Type-locality: Boothia Peninsula, North West Territories.
O. p. katahdin (Newcomb, 1901)
Type-locality: Mount Katahdin, Maine.
O. p. peartiae (Edwards, 1897)
Type-locality: Winter Cove, Cambridge Bay, North West Territories.
**O. p. brucei* (Edwards, 1891)
Type-locality: Bullion Mountain, Hall Valley, Park County, Colorado.
O. p. yukonensis Gibson, 1920
Type-locality: unavailable.

Notes. –

There appears to be a gap in the distribution of *O. p. brucei*. It is not reported from Montana or southern Alberta. *O. b. edwardsi* shows a similar gap. These two species are very similar, and in both, adults fly early in the season. It is possible that this gap represents a temporal collecting bias, and not an actual disjunction.

O. p. brucei was first collected in Alberta in the vicinity of Banff. Adults are more commonly encountered north of Banff than south. This species has not been reported from southern British Columbia, being restricted, like *O. b. edwardsi*, to the front ranges east of the Rocky Mountain Trench.

Geographical Distribution. –

Distribution is indicated in Figure 17. This species has been reported from Alaska, the Yukon Territory, arctic North West Territories excluding the high arctic islands, Quebec, Manitoba, Labrador, northern British Columbia, Alberta, Wyoming, Colorado, and Maine. Alberta distribution is indicated in Figure 35.

Material examined: 283 specimens.

675 *Erebia magdalena* Strecker, 1880

Two subspecies are recognized.

E. m. magdalena Strecker, 1880

Type-locality: Mountains near Georgetown, Colorado.

E. m. mackinleyensis Gunder, 1932

Type-locality: Sable Pass, Mount McKinley National Park, Alaska.

Notes. –

In spite of intensive collecting, this species has not been reported from north of the Beartooth Plateau, Montana, or south of the Yukon Territory. The two subspecies are fairly distinct.

Geographical Distribution. –

Distribution is indicated in Figure 18. This species is known from Alaska, the Yukon Territory, Montana, Wyoming, Utah, Colorado, and New Mexico.

Material examined: 25 specimens.

676 *Erebia fasciata* Butler, 1868

Two subspecies are recognized

E. f. fasciata Butler, 1868

Type-locality: Victoria Island, North West Territories.

E. f. avinoffi Holland, 1930

Type-locality: Kotzebue Sound, Alaska.

Geographical Distribution. –

Neartic distribution is indicated in Figure 19. This species is known from Alaska, the Yukon Territory, and arctic North West Territories excluding the high arctic islands and Baffin Island. It is also recorded from Asia.

Material examined: 25 specimens.

677 *Erebia youngi* Holland, 1900

Three subspecies are recognized.

E. y. youngi Holland, 1900

Type-locality: Mountains between 40 mile and Mission Creeks, Alaska.

E. y. herscheli Leussler, 1935
Type-locality: Herschell Island, Yukon Territory.
E.y. rileyi dos Passos, 1947
Type-locality: Mount McKinley National Park, Alaska.

Notes. –

Adults of this species are easily confused with those of *E. dabanensis*; records of one may easily refer to the other.

Geographical Distribution. –

Distribution is indicated in Figure 20. This species is also recorded from Asia. In North America, it is found in Alaska, the Yukon Territory and western-most arctic North West Territories.

Material examined: 12 specimens.

Erebia dabanensis Erschoff, 1871
Type-locality: Chamar-daban, Urkutsk, U.S.S.R.

Notes. –

This species has tentatively been identified from a number of localities in Alaska. The specimens may represent *E. youngi*. Details for their separation are given in Warren (1936).

Geographical Distribution. –

Distribution is indicated in Figure 21. So far, this species has only been reported from Alaska and eastern Asia.

Material examined: 1 specimen.

Erebia inuitica Wyatt, 1966
Type-locality: Anaktuvuk Pass, Alaska.

Notes. –

This species has not been collected since its description.

Geographical Distribution. –

The type-locality is indicated in Figure 22.

681 *Erebia callias* Edwards , 1871
Type-locality: Colorado.

Notes. –

E. callias is common in the southern Rocky Mountains. It is the only endemic butterfly in the southern Rocky Mountains that is restricted to tundra.

Geographical Distribution. –

Distribution is indicated in Figure 23. It is recorded from Montana, Wyoming, Utah, and Colorado. It has also been reported from Asia.

Material examined: 23 specimens.

Twelve taxa are known from Alberta. Their distributions are shown in Figures 24 through 35. These taxa are:

C. n. streckeri Figure 24
L. p. arethusa Figure 25
L. s. snowi Figure 26
E. e. beani Figure 27
B. n. reiffi Figure 28
B. alberta Figure 30
B. astarte Figure 31
*B. e. nichollae*Figure 32
O. b. edwardsi Figure 33
O. m. beani Figure 34

B. i. youngi Figure 29 *O. p. brucei* Figure 35

These twelve taxa are grouped into four types of distribution patterns: Southern Montane, Central Montane, Disjuncts, and Endemics.

TYPE 1 - Southern Montane (Figure 36a)

This pattern includes five taxa whose ranges extend from Alberta south to the Montana-Wyoming border, or beyond to Colorado and New Mexico.

L. p. arethusa *O. b. edwardsi*
O. p. brucei *O. m. beani*
L. s. snowi

TYPE 2 - Central Montane (Figure 36b)

This group includes four taxa not found north of the British Columbia-Yukon Territory border, or south of northern-most Montana and Washington.

C. n. streckeri *B. alberta*
E. e. beani *B. astarte*

TYPE 3 - Disjuncts (Figure 36c)

One taxon found in Alberta represents a disjunction from a northern population. There do not appear to be any disjunctions from southern populations.

B. i. youngi

TYPE 4 - Endemic forms (Figure 36d)

Included here are two taxa known only from the central Canadian Rocky Mountains.

B. e. nichollae *B. n. reiffi*

Possibly three other taxa may be placed here. As mentioned earlier, the Alberta population of *Boloria improba* may represent an undescribed subspecies. Also, *O. m. beani* from around Prospect Mountain shows an ecological specialization which may deserve recognition, and the one specimen of *L. p. arethusa* from above treeline at Prospect Mountain is very different from normal *arethusa*. This may be an aberration, or it may represent an undescribed taxon.

DISCUSSION

In general, distribution patterns are determined in part by ecological tolerances, or proximal factors, and in part by past events, or historical factors (Udvardy, 1969; Larsen and Barry, 1974; Löve and Löve, 1974). I have not attempted to study explicitly by experimental means those factors involved with ecological tolerance. Rather, I accept that such exist, and assume that the tundra butterflies of Alberta exist in such areas because the latter are favorable. Further, I assume that these taxa do not live elsewhere in geographically proximal areas, because they cannot tolerate other ecological conditions, either biotic or physical. I concentrate on explaining the historical concomitants of the distribution patterns.

In general, historical explanations depend on a series of hypotheses, because the determining events were not observed, and thus their existence and interrelations must be inferred from evidence that is presently available. However, meaningful inferences cannot be generated *in vacuo*. Rather, they are based on assumptions that must be regarded, for the sake of a given set of circumstances, as axiomatic. My assumptions are as follows.

1. Climatic events of the Wisconsin glacial stages influenced the distribution patterns of extant butterfly taxa of tundra areas of Alberta. There is a vast amount of data which document the effects of this glaciation on other groups of animals and plants. For the

present, these effects are assumed for the tundra butterflies as well. Specific indications derived from distribution patterns shown by tundra butterflies are discussed in the section on source areas of this fauna.

2. Unglaciated areas of the eastern slopes of the Rocky Mountains were habitable during glacial times.

   This assumption is necessary to explain the presence of disjunct populations of non-butterfly taxa in the study area, given that these disjunctions are not artifacts and are interpreted correctly. Geological data (Roed, Mountjoy, Rutter, 1967; Rutter, 1972; Boydell, 1972; Curry, 1976; Reimchen and Bayrock, 1977; Stalker, 1977; Alley, 1973; Jackson, 1977; Reeves, 1973) indicate the likelihood that this assumption is valid.

3. Immediate ancestral stocks of all species of butterflies that are included in each distribution type survived together in the same refugium.

   This assumption is required to explain the fact that more than one taxon shows a given distribution pattern.

4. Dispersal of tundra adapted stocks has been slow and orderly. This has been the result of the non-random and gradual retreat of Wisconsin ice sheets. Because life spans are short, and flight capabilities are generally poor; tundra butterflies do not appear to be suited to dispersal over long distances.

5. Evidence of endemism is evidence of isolation of such stocks from other populations for a period of time that extends from the present to at least the end of the Sangamon interglacial stage.

Genetic change usually requires a period of isolation (see Morisset, 1971, and Packer, 1971, for discussions in the context of endemism and refugia). Endemism is one way that such genetic change is expressed. The end of the Sangamon interglacial is the last possible time that endemic populations could have been genetically continuous with ancestral populations of other forms.

Explanation of the distribution patterns of the tundra butterflies of Alberta requires postulation of source areas of these populations. There are three potential source areas: Beringia, Continental North America south of Wisconsin ice, and one or more refugia within the limits of continental ice along the Rocky Mountains in Alberta and British Columbia. Two are external to Alberta: Beringia, and Continental North America south of Wisconsin ice. One includes the eastern slopes of the Rocky Mountains, that is, an internal refugium in the sense that it was probably surrounded by ice at the height of the Wisconsin glacial stage.

Existence of the external source areas is well established by an abundance of evidence. Existence of the internal source area is based on less extensive evidence: at least twelve plant taxa have disjunct populations in the front ranges of the Rocky Mountains (Packer and Vitt, 1974) as do three species of beetles (Belicek, 1976; Ball, pers. comm.), and one crustacean. The endemic species of crustacean which has been reported (Clifford and Bergstrom, 1976) is of questionable value in this context.

Extensive areas surrounded by ice were probably available in Alberta during Wisconsin time for habitation, although much of the unglaciated area was likely bedrock, and probably too rugged and too high to support tundra vegetation. Today, distribution of disjunct taxa is concentrated along the front ranges of the Rocky Mountains, and especially in the Mountain Park area. Endemic taxa are also centered in this area. Possibly the refugium was located in this area during the Wisconsin stage.

Figure 37 indicates the approximate limit of Wisconsin ice in the Mountain Park area. A high ridge on the western side, which now forms the Jasper National Park boundary, would have prevented ice from entering this area from the west. The northern boundary has been documented as Cordilleran ice in the Athabasca River Valley which coalesced with laurentide ice in the vicinity of Hinton (Roed, Mountjoy, and Rutter, 1967) See Figure 5. The eastern boundary would most likely have been somewhere in the foothills, or the eastern slopes of Cadomin and Red Cap Mountains. The southern boundary is uncertain, and the refugium may have extended south to Nordegg, where ice in the Saskatchewan River Valley would have formed a barrier. The area encompassed is a series of valleys and ridges which run in an east-west direction. They provide, at present, considerable and varied alpine habitat. All ice present in the refugium during Wisconsin time would have been thin and of local derivation. It is probable that small pro-glacial lakes were present during the height of glaciation, being formed by summer melt waters off the ice and from annual snow fall. Alpine tundra could have maintained an extent and position similar to that at present.

Of the three possible source areas listed above, I believe that only two contained immediate ancestors of the extant populations under consideration. My major hypotheses, then, are:

1. The source area for butterflies with distribution types 1 and 2 was an external refugium south of the ice.
2. The source area for butterflies with distribution types 3 and 4 was an internal, or Albertan refugium.

Each of these hypotheses is discussed below. Additionally, a series of secondary hypotheses is presented in conjunction with locating more precisely the source area of the butterflies from the external refugium south of Wisconsin ice.

The source area of the nine taxa in groups 1 and 2 is placed south of Wisconsin ice for the following reasons.

Of the nine species involved, five also live in Beringia, and are represented there by distinctive forms. Alberta material is easily allied with southern forms in all five species. None of the Beringian forms even approach the Alberta border to the north.

The remaining four species are not in Beringia, and two have clear relationships with southern taxa. This suggests that they evolved south of the Wisconsin ice sheets.

No tundra butterflies in Beringia have dispersed south into and still survive in Alberta.

In the Trichoptera (Nimmo, 1971) and Coccinellidae (Belicek, 1976) faunas that have been investigated, only a very small proportion has been derived from Beringia. This includes all habitat types. Of all Alberta s butterflies, the source area of only one can be identified as Beringia. This suggests that not only tundra elements, but all elements of the Beringian fauna could not easily migrate south, including the boreal forest communities.

If these taxa survived Wisconsin glaciations in the Alberta refugium, there are a number of indications that might be expected.

First, we might expect that some of these taxa would have dispersed north from the refugium as well as south. There would not be barriers to entry into Alaska for the four species not present there now. We would also expect that some of the distinctly alpine taxa would be found on arctic tundra in the North West Territories. These possibilities have not been realized. It is possible that some of these taxa survived in the Alberta refugium, but have not contributed to colonization of other areas, however, in the absence of endemic tendencies, these cannot be identified.

It is also unlikely that taxa surviving in the Alberta refugium could have dispersed as far as New Mexico in post-glacial times, but not into the coastal ranges of Washington, Oregon, and California. This would imply long distance dispersal between mountain ranges, and the gaps in habitat are similar in size on both the eastern and western mountain ranges.

In order to locate the source area of types 1 and 2 more precisely, the following hypotheses are made.

1. Taxa in types 1 and 2 survived the Wisconsin glaciation in the same refugium.
2. Dispersal south into Wyoming and Colorado from this refugium was blocked by gaps in habitat.
3. The tundra belt south of the ice sheet was very narrow and broken. This prevented dispersal east to New England and Quebec.
4. Dispersal west and south along the coastal ranges was blocked by large gaps in habitat in central Washington.

These hypotheses are discussed below.

1. Taxa in types 1 and 2 survived together.

   These taxa have similar boundaries on three sides of their present ranges. This indicates that they are responding to retreat of Wisconsin ice in a similar manner. If so, it is reasonable to expect that they would respond to the Wisconsin ice advances in a similar manner as well, and that as they were displaced south, and northern colonies were extinguished, the surviving colonies would be found in about the same area.

   Type 1 distributions have been identified in plants (Packer and Vitt, 1974), Trichoptera (Nimmo, 1971), and Coccinellidae (Belicek, 1976). Type 2 distributions have been identified in Trichoptera (Nimmo, 1971), but not in plants or Coccinellidae. At least one species of carabid beetle shows this type of distribution: *Nebria schwarzi*. This indicates a fairly general phenomenon, and that large elements of the tundra community were involved. This is to be expected if the hypothesis is correct.

2. Dispersal from this refugium south was blocked by gaps in habitat.

   This hypothesis is necessary to explain the fact that type 2 taxa have not dispersed farther south, where there appears to be ample suitable habitat, and empty niches available. Because there are no plant taxa which show this type of distribution, these butterfly taxa are not limited by foodplant distribution. It would seem that they have been physically blocked from dispersing south. The only reasonable explanation is that tundra was not very extensive, and that these taxa are not capable of crossing even minor gaps in habitat. In other words, dispersal can only be accomplished if the habitat is continuous. By hypothesizing a narrow tundra belt, breaks would occur in the belt in the vicinity of central Montana, which is where the barrier seems to have been.

   Also in support of this hypothesis is the fact that the two endemic taxa in the southern Rocky Mountains have not been able to disperse north across this barrier.

   It would appear that the presence of type 1 taxa in the southern Rocky Mountains would weaken this argument. However, because two of these taxa are derived from non-tundra species which evolved below the ice margin, their presence probably dates to pre-Wisconsin times. Also, because the three species on isolated tundra in New England and Quebec are also in the Rocky Mountains, they must either be capable of much better dispersal, or they must have had more time to reach these areas. While they may be more efficient at dispersing than other tundra butterflies, they have not managed to invade the arctic islands very successfully, which weakens the suggestion that they extended their

ranges into the southern Rocky Mountains in post-Wisconsin times.

If they were present in North America during earlier, more extensive glaciations, not only would the extent of tundra be greater, and therefore the gaps smaller, but they would have had considerably more time to spread through the southern Rocky Mountains. It is suggested, therefore, that these taxa represent elements of an older dispersal south, perhaps during Illinoisan or Nebraskan glaciations. This might also explain the presence of *E. magdalena* and *E. callias* in Colorado and Wyoming.

3. The tundra belt along the southern margin of Wisconsin ice was discontinuous.

   Six of the nine species under discussion are not represented in the isolated tundra of New England and Quebec. The three tundra species there are represented by subspecies that are more closely related to subspecies in Labrador and the eastern arctic. This indicates that a major barrier was present. Because the six species that are absent inhabit a variety of habitats, and two of them inhabit all tundra areas except New England, Quebec, and the southern Rocky Mountains, it is reasonable to expect that the nature of this barrier had to be a break in the tundra belt. Otherwise, at least one or two of these species would be expected on the tundra in New England and Quebec, and the relationship would be closer between eastern and western populations of the three species found on both sides of this barrier.

   Based on pollen core data, similar conclusions have been reached with respect to the discontinuous tundra belt (Löve, 1959; Ritchie, 1969; Wright, 1970).

4. Dispersal west and south along the coastal ranges was blocked by large gaps in habitat in central Washington.

Only two of the twelve species in Alberta are also on the coastal ranges, where each is represented by a different subspecies. Tundras from Oregon south to the Sierra Nevada are the most depauperate in terms of tundra butterflies, in North America. This indicates a major barrier. If minor barriers prove to be effective for these butterflies, distances between the mountain peaks in Oregon and southern Washington would be almost insurmountable. This is in keeping with the suggestion that the nine taxa in types 1 and 2 are unable to cross unfavorable habitat, and necessitates only one assumption to explain all boundaries and barriers encountered in this study.

It appears that tundra plants are also reacting to this barrier. According to Billings (1974), only 20% of the flora of the tundra of the Sierra Nevada has affinities with northern and arctic tundra floras. Of all known tundra in North America, this, and that of the Great Basin, are the most depauperate in arctic-alpine species.

The hypothesis seems to explain all the available data, while being contradicted by none. As more groups are investigated, particularly Carabidae, and the infraspecific relationships in the flora between the tundra areas discussed above, further tests of the hypothesis can be made.

The probable extent of the external refugium is indicated in Figure 43.

Before an attempt is made to locate the source area for butterflies with distribution types 3 and 4, it is necessary to discuss the assumptions that the distributions known for these taxa are accurate.

The only taxon that shows a clear disjunction is *B. improba youngi*, which is represented in Alberta by a population disjunct from arctic Canada and Alaska. Collecting in the gap has been minimal, so there is a possibility that this disjunction is an artifact, in which instance, this would represent the only dispersal into Alberta from the north in Post-glacial times. Because of the phenotypical differences between the Prospect Mountain population and the populations in

the north, and because this species has not been found on the mountains in the vicinity of Prospect Mountain, I suspect that it probably represents a real disjunction. This would indicate either long distance dispersal, or survival in the area during the Wisconsin. Because of the distances involved (over 600 km.) it is unlikely that this represents long range dispersal. Adults of this species are very weak fliers. The presence of a disjunct population in Colorado supports the hypothesis that this species has a relict distribution in the Rocky Mountains, and that this distribution is in part due to Wisconsin events.

Two taxa in type 4 may represent endemic forms. *B. e. nichollae* is very distinctive. *B. n. reiffi* is largely unknown. The type specimen appears to have been lost, and no specimens have been found that fit the type description. Alberta material has not been studied. A short series from Pink Mountain, British Columbia has not been examined because of lack of material from the Yukon Territory and Alaska for comparison. This species must have been present before the Wisconsin glaciations because there is one disjunct population in Wyoming which represents a different subspecies.

The only feasible explanation for the presence of types 3 and 4 distributions is that these taxa survived at least the Classical Wisconsin glaciation in the Alberta Refugium.

Barriers to dispersal appear to be either lack of suitable habitat, or selection against dispersal during glaciations. This has been suggested for Carabidae (Lindroth, 1949).

Colonization of present day tundra in Alberta

In this section I will discuss the contribution and dispersal routes from each of the two refugia into Alberta tundra.

Dispersal of taxa which survived Wisconsin glaciations in the Alberta refugium has been minimal. *B. e. nichollae* has dispersed west and south to areas within a 40 km. radius of Prospect Mountain, *B. n. reiffi* and *B. i. youngi* are now located to the north of the refugium, which may indicate Post-glacial dispersal, or possibly that the refugium extended north of the Athabasca River Valley as a series of broken nunataks. If the ecological form of *O. m. beani* found in this area survived in the refugium, it has dispersed about the same amount as *B. e. nichollae*. This refugium does not seem to have contributed much to the colonization of Alberta tundra in Post-glacial times.

With respect to the external refugium, as Wisconsin ice retreated, the tundra south of the ice is expected to have followed the ice margins north. As the tundra moved northward, the tundra butterflies would have as well. Boreal forest following behind the tundra would first invade valleys, gradually isolating pieces of tundra on mountains. With the continued movements of both communities north, these isolated tundras would slowly move up the mountains to the summits as conditions for tree growth improved lower down. As ice retreated still farther, Laurentide ice withdrew to the east across northern Alberta and what is now the barrenlands of the North West Territories. The tundra belt followed the ice movements and boreal forest eventually replaced tundra in all the mountain valleys creating a series of isolated tundra communities on mountain summits. The breakup of continuous tundra in the mountains effectively halted the dispersal north of tundra butterflies. The migration of the biota in this refugium is summarized in Figure 38.

Because Cordilleran ice in northern British Columbia and the Yukon Territory did not break up until well after Laurentide ice had retreated eastward, Beringian flora and fauna were blocked from dispersing south by the presence of intact tundra and boreal forest communities derived from south of the ice sheets. In other words, the Beringian communities were blocked

first by ice barriers, and later, by inter and intra specific competition.

CONCLUSIONS

Two Wisconsin butterfly refugia can be identified in the Rocky Mountains of Alberta and adjacent areas. The first, Mountain Park, did not have a significant role in re-colonizing Alberta after the ice retreated. The second, northern Washington, Idaho, and Montana, was an important dispersal center for butterflies. Tundra butterflies are the only direct living indication that the tundra belt south of the ice margin was not continuous.

This suggests that the tundra butterfly fauna has an important potential as an indicator of refugia, and should be investigated whenever a study on the location of a refugium is undertaken.

The importance of refugia is twofold. They serve as centers of dispersal, and as centers for the development of new taxa. This study also suggests that large refugia tend to act as centers of dispersal, and that small refugia tend to serve as centers for the development of new taxa.

Where areas surrounded by ice have been identified by geologists, evidence which indicates refugia has usually been found by biologists, but geologists cannot determine the limits of a given community type within the boundaries of an open, or continental refugium. Only investigation of the biological components can determine these limits with accuracy.

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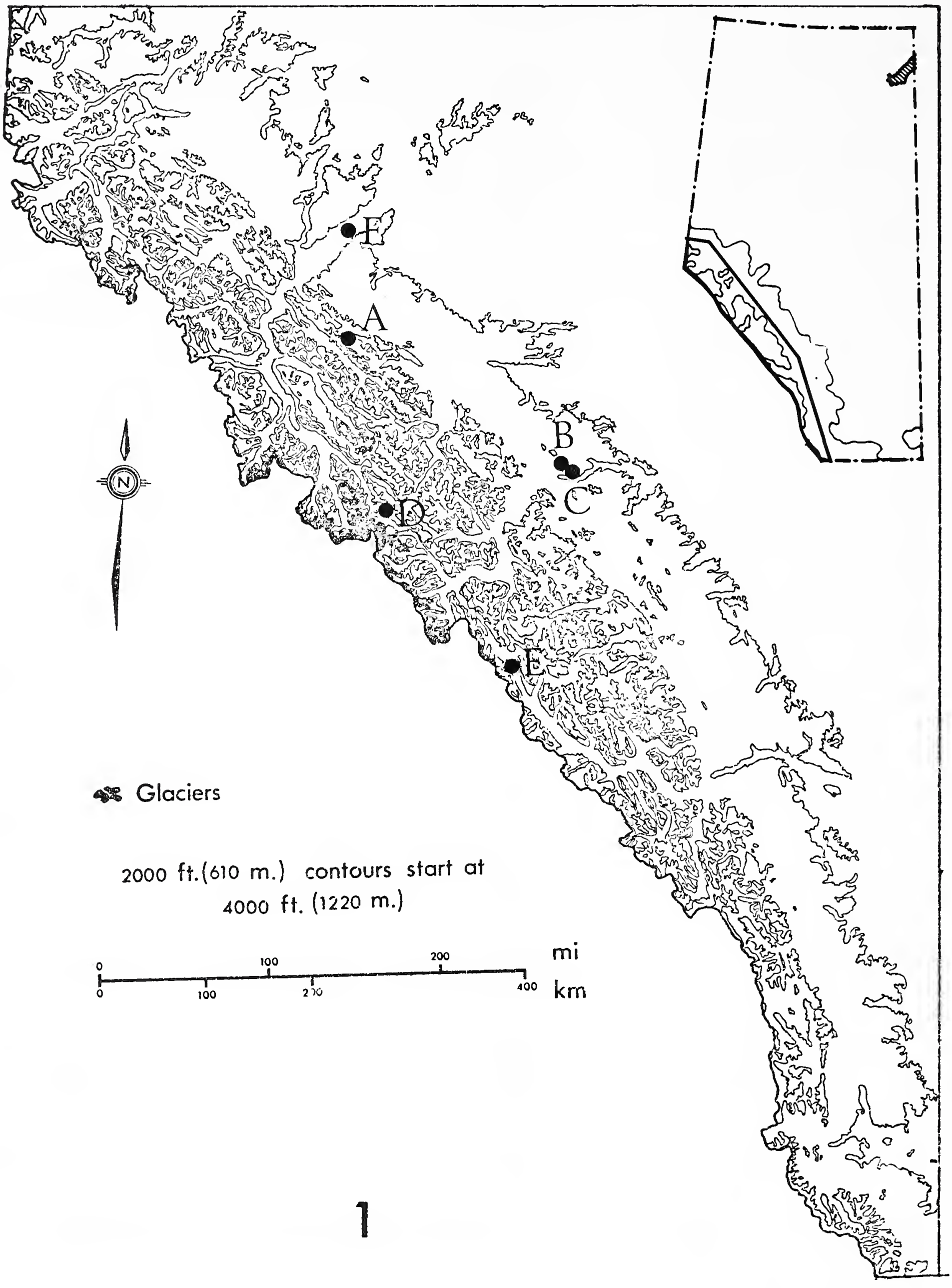
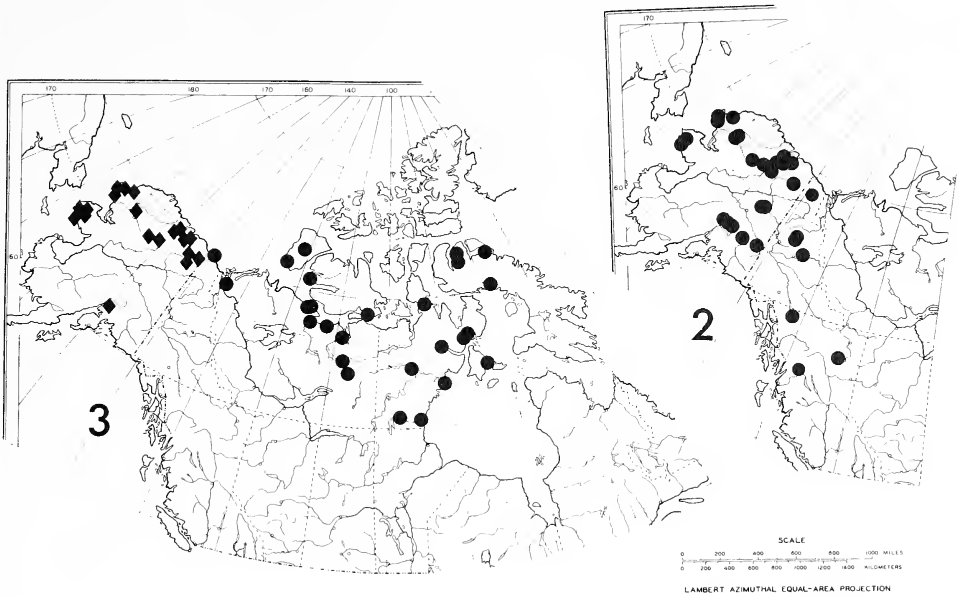


Fig. 1. Important localities mentioned in the text.
A–Prospect Mountain (Mountain Park); B–Shunda Mountain; C–Coliseum Mountain; D–Wilcox Pass; E–Laggan (Lake Louise); F–Hinton.



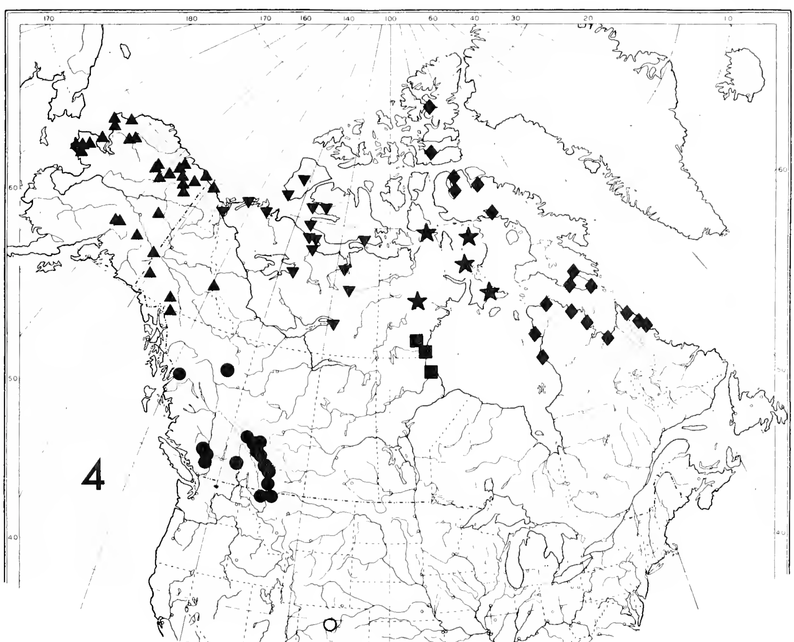
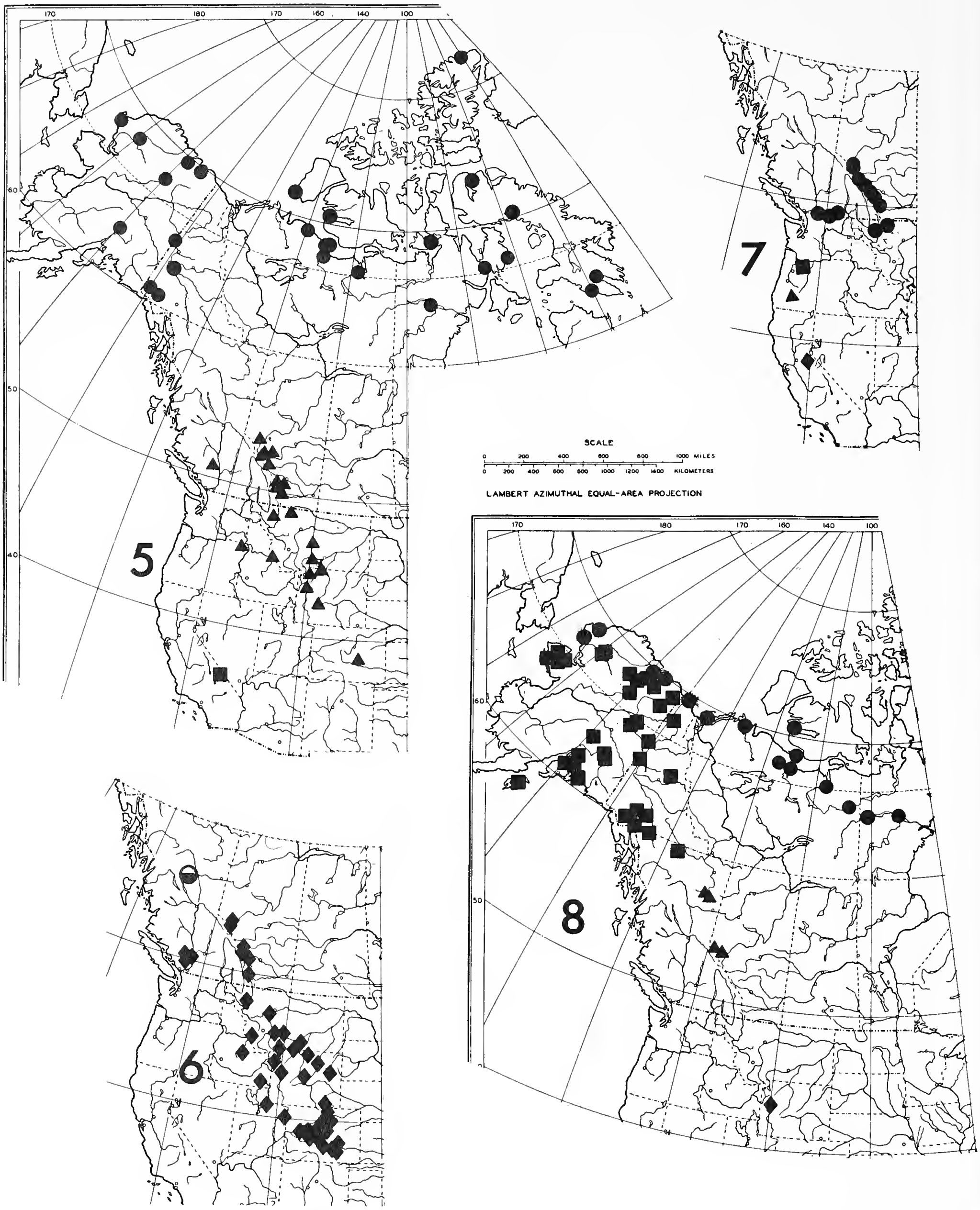


Fig. 2–4. Distribution of butterfly species and subspecies in North America.
Fig. 2. *Parnassius eversmanni thor.* Fig. 3. ● *Colias boothii;* ◆ *C. nastes thula.* Fig. 4. ◆ *Colias n. nastes;* ★ *C. n. rossii;* ■ *C. n. moina;* ● *C. n. streckeri;* ▼ *C. n. cocandicides;* ▲ *C. n. aliaska* unverified record. See Fig. 3 for range of *C. n. thula.*



Figs. 5–8. Distribution of butterfly species and subspecies in North America.
Fig. 5: ● *Lycaena phlaeas feildeni;* ▲ *L. p. arethusa;* ■ *L. p. hypophlaeas.* Fig. 6: ◆ *Lycaena s. snowi;* ⊖ *L. s. henryae.* Fig. 7: ● *Euphydryas editha beani;* ◆ *E. e. nubigena;* ■ *E. e. colonia;* ▲ *E. e. lawrenci.* Fig. 8: ■ *Boloria napaea alaskensis;* ● *B. n. nearctica;* ▲ *B. n. reiffi;* ◆ *B. n. halli.*

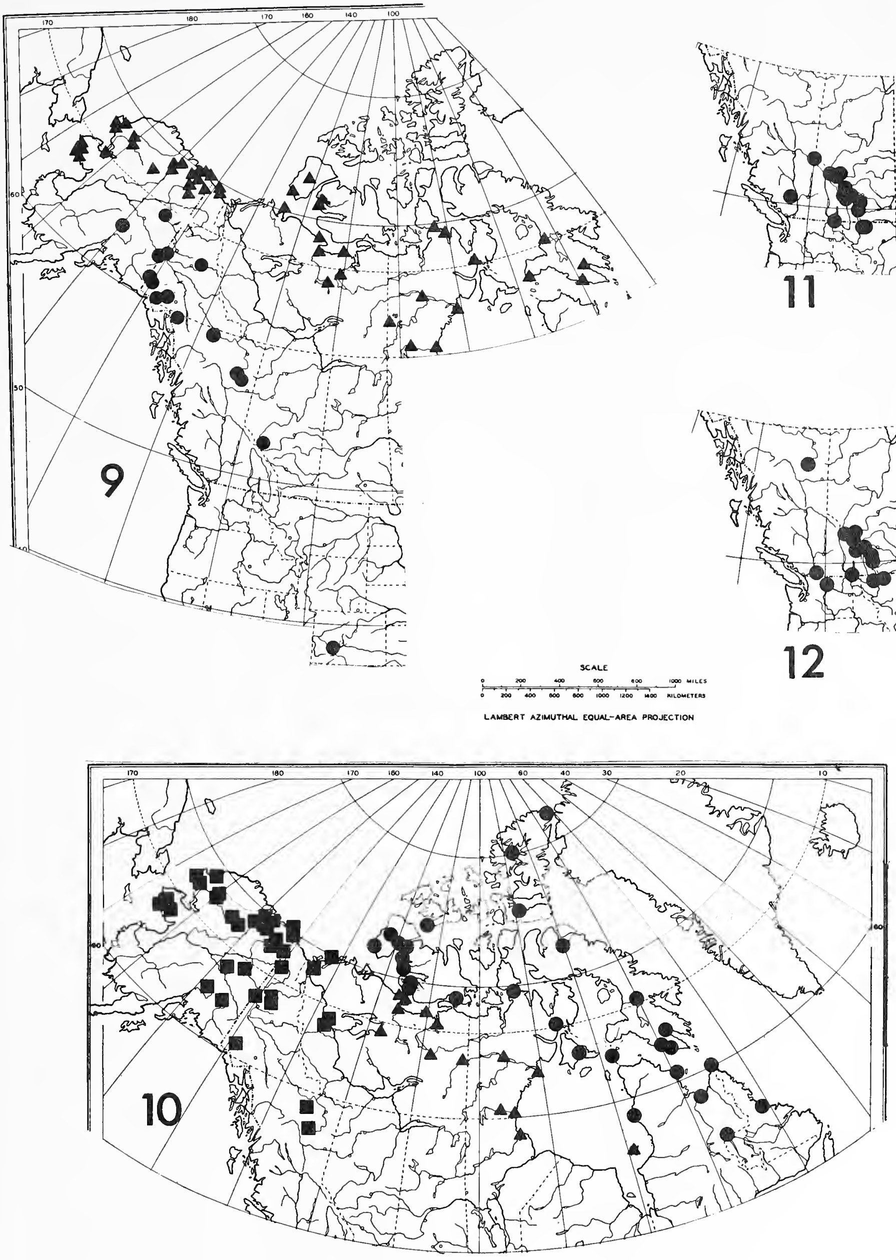
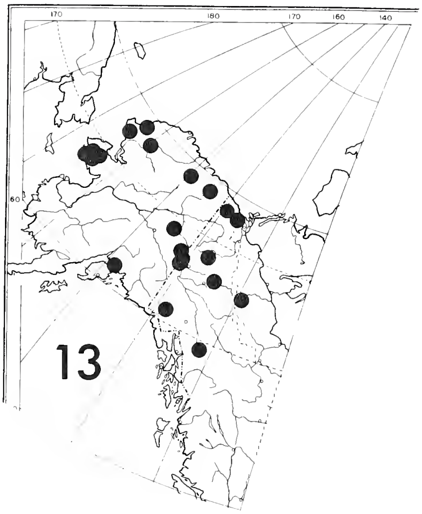
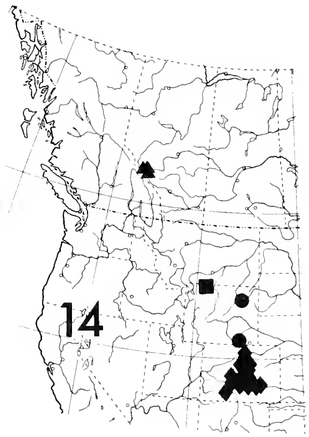


Fig. 9–12. Distribution of butterfly species and subspecies in North America.
Fig. 9: ▲ *B. i. improba;* ● *B. i. youngi*. Specimens from the locality in Colorado have been described as *B. acrocnema* Gall and Sperling, 1980. Fig. 10: ■ *Boloria p. polaris;* ● *B. p. groenlandica;* ▲*B. p. stellata;* identification uncertain. Fig. 11: *Boloria alberta;* Fig. 12: *Boloria astarte.*





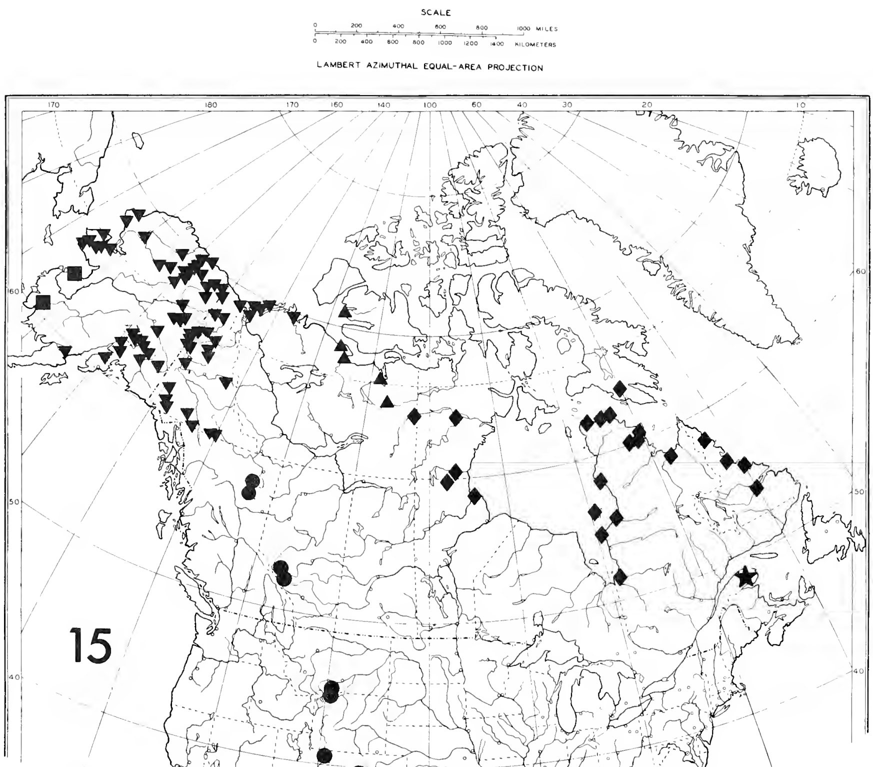
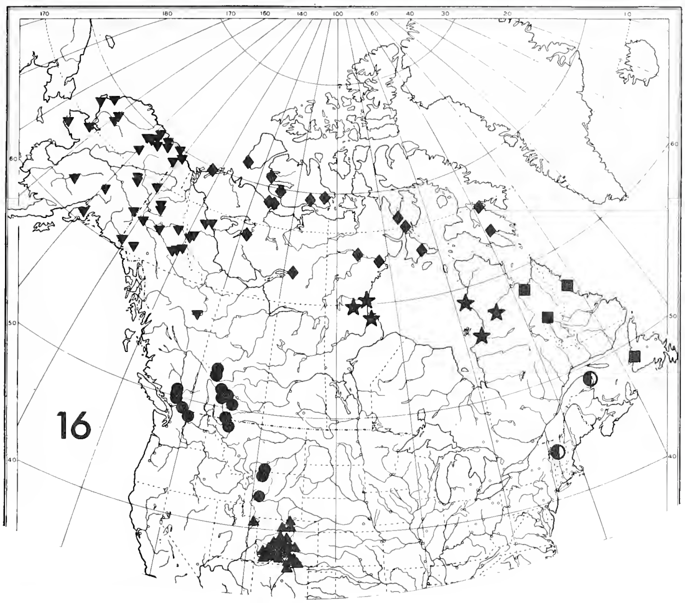
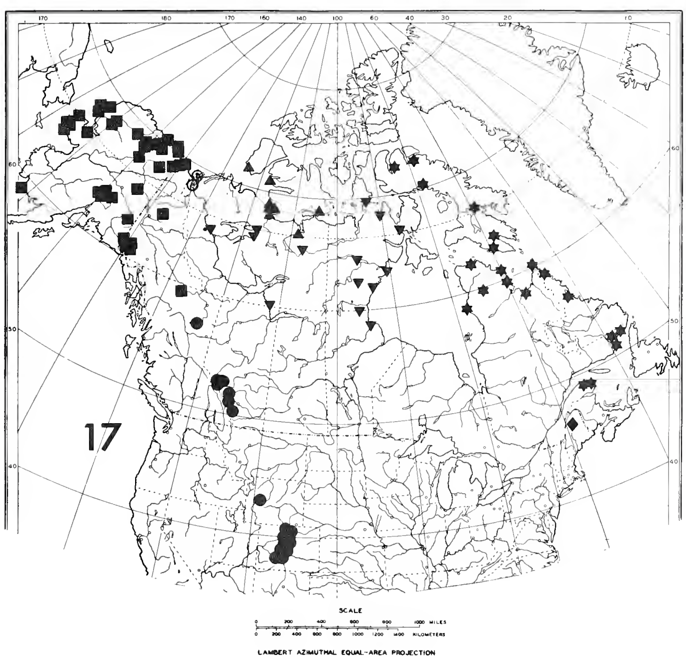
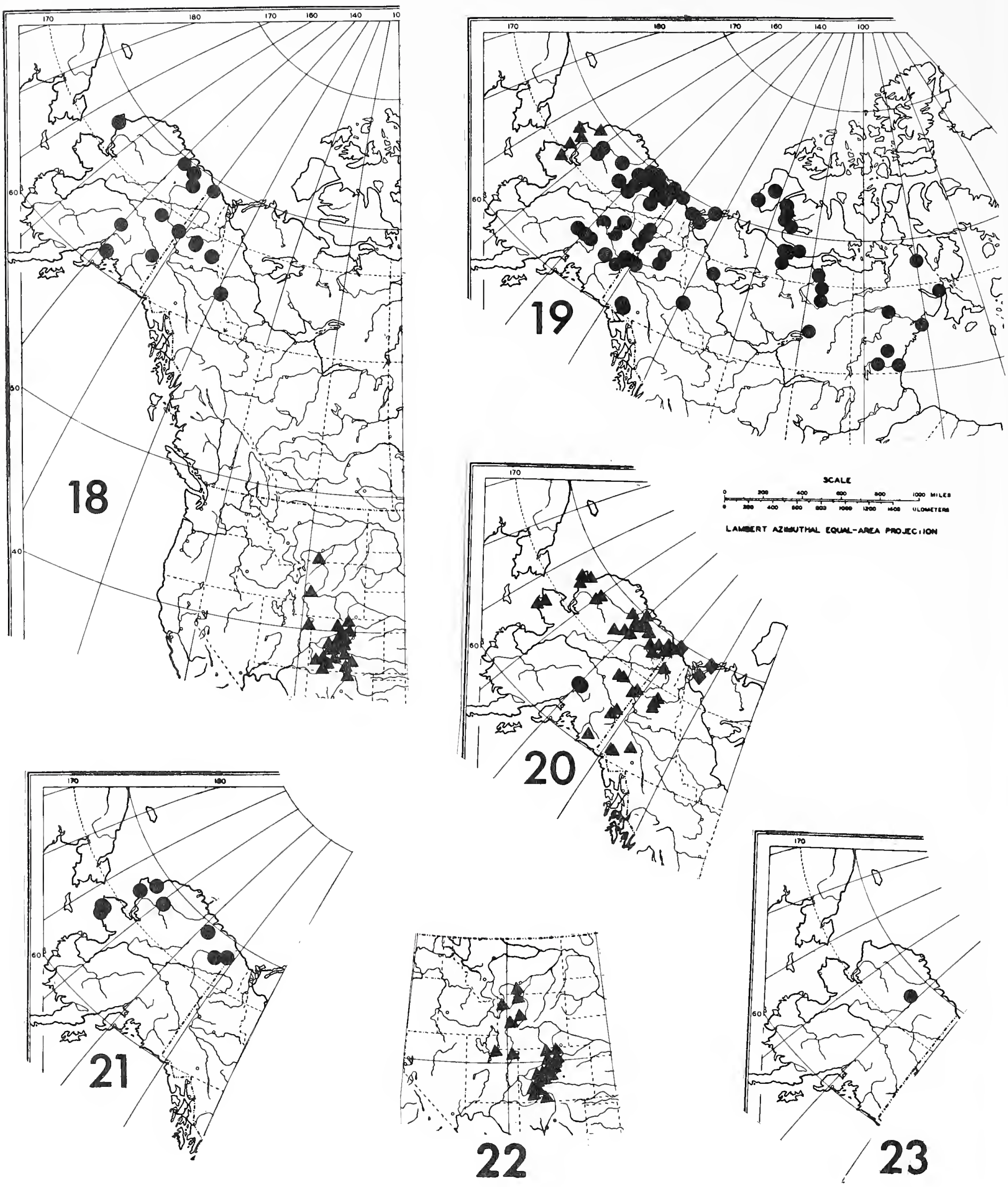


Fig. 13–15. Distribution of butterfly species and subspecies in North America.
Fig. 13: *Boloria distincta.* Fig. 14: ▲ *Bolaria eunomia nichollae;* ■ *B. e. ursadentis;* ● *B. e. laddi;* ◆ *B. e. caelestis.* Fig. 15: ◆ *Oeneis bore taygete;* ★ *O. b. gaspeensis;* ■ *O. b. fordi;* ● *O.b. edwardsi;* ▲ *O. b. hanburyi;* ▼ *O. b. mackinleyensis.*

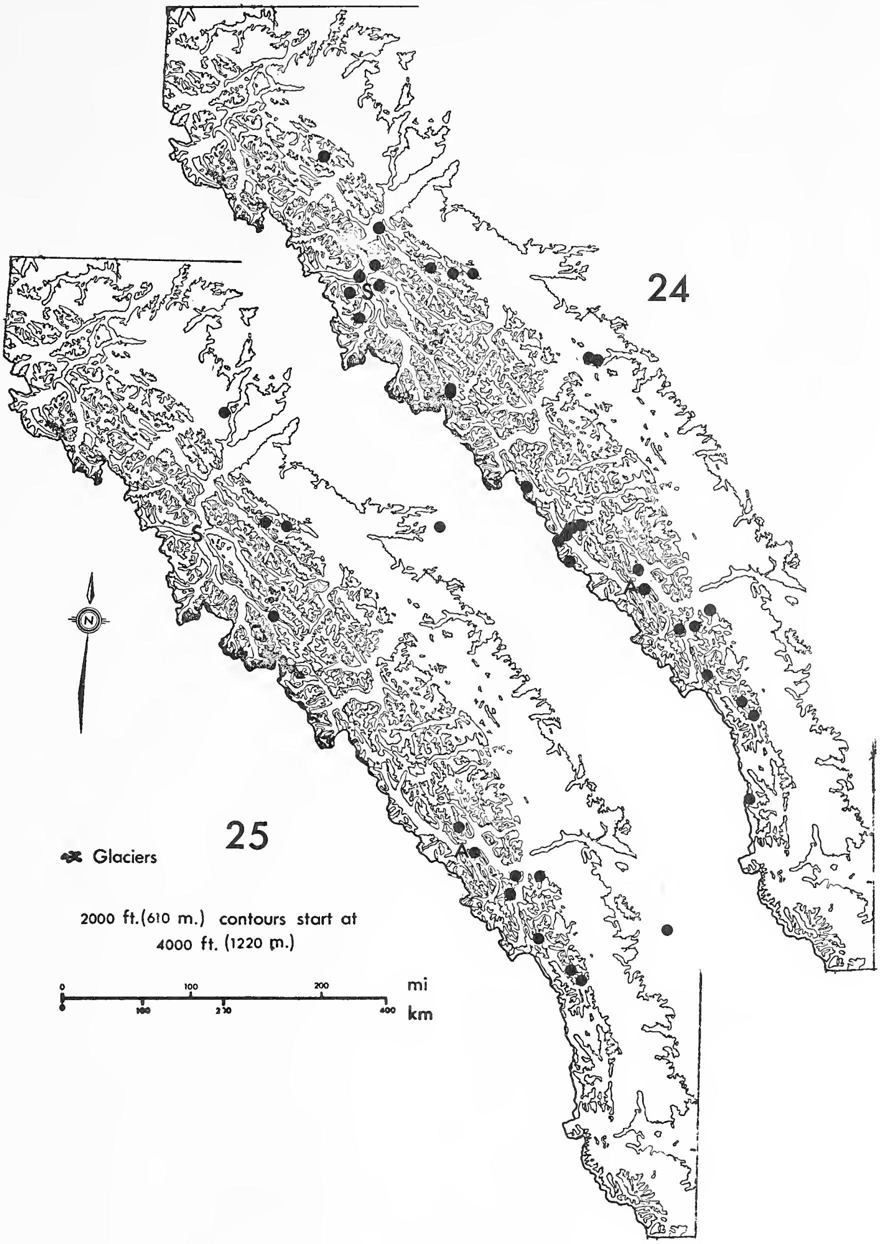




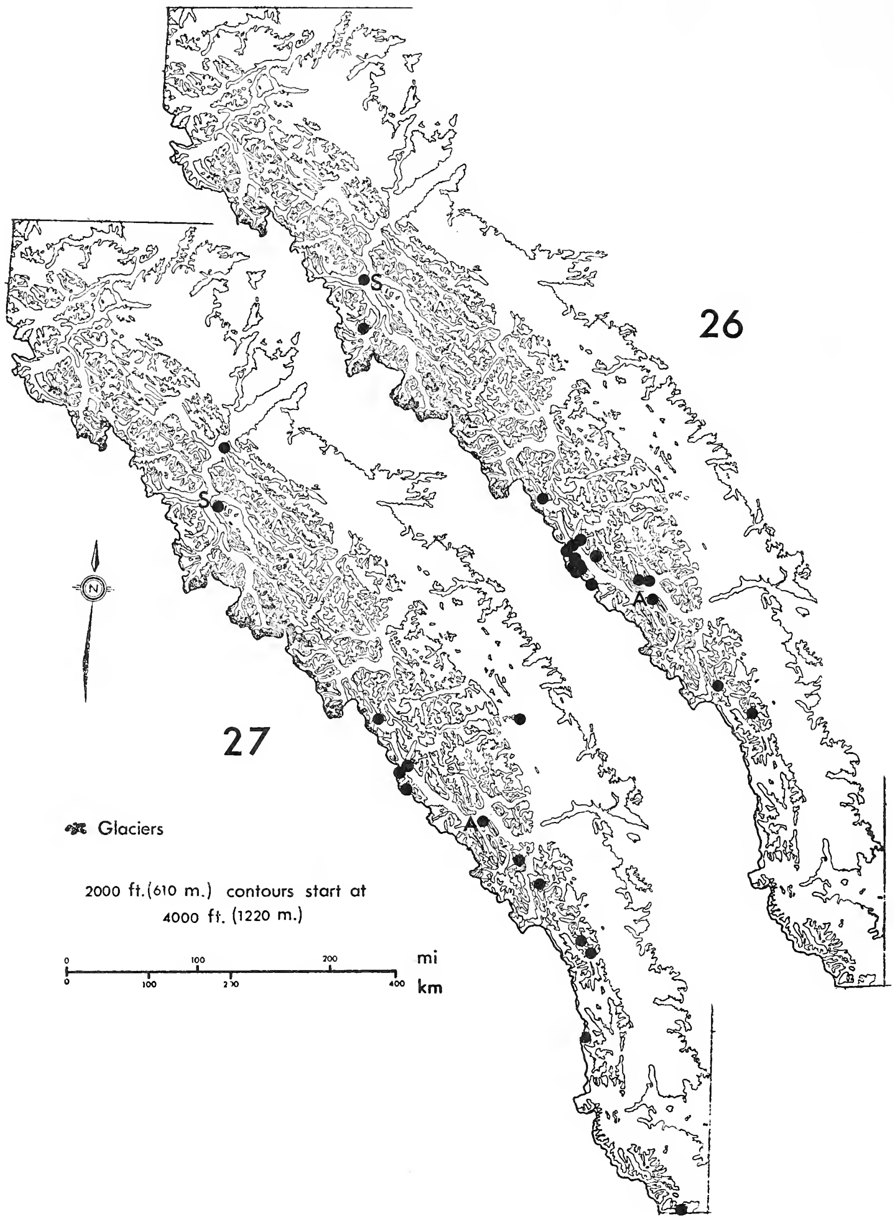
Figs. 16- 17. Distribution of butterfly species and subspecies in North America.
Fig. 16: ■*Oeneis m. mellissa;* ★*O. m. semplei;* ◆*O. m. assimillis;* ▼*O. m. gibsoni;* ▲*O. m. lucilla;* ●*O. m. beani;* ◐*O. m. semidea.* Fig. 17: ✱*O. p. polixenes;* ▼*O. p. subhyalina;* ◆*O. p. katahdin;* ▲*O. p. peartiae;* ●*O. p. brucei;* ■*O. p. yukonensis.*



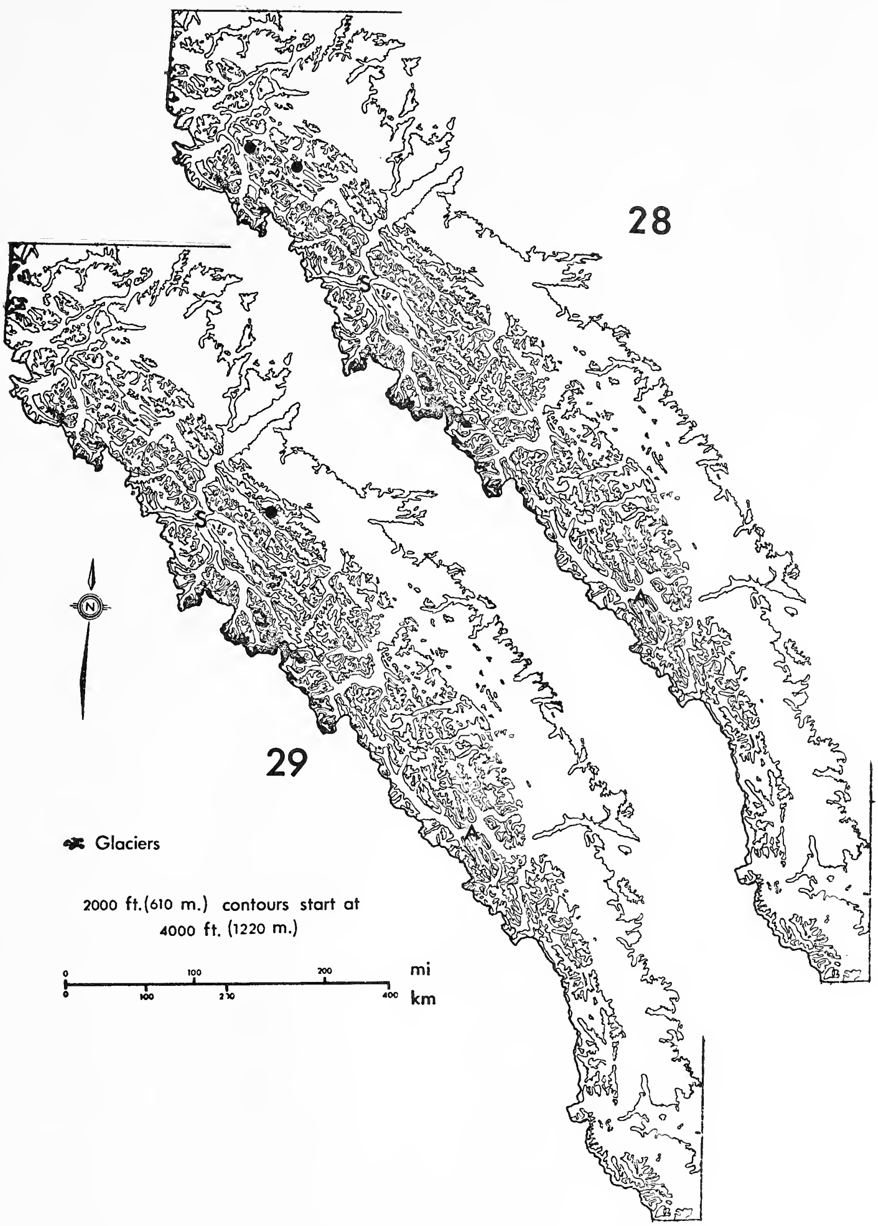
Figs. 18–23. Distribution of butterfly species and subspecies in North America.
Fig. 18: ▲*Erebia m. magdalena;*●*E. m. mackinleyensis. Fig. 19:*●*Erebia f. fasciata;* ▲*E. f. avinoffi.* Fig. 20: ▲ *Erebia y. youngi;* ◆*E. y. herscheli;*●*E. y. rileyi.* Fig. 21: *Erebia dabanensis.* Fig. 22: *Erebia callias.* Fig. 23: *Erebia inuitica.*



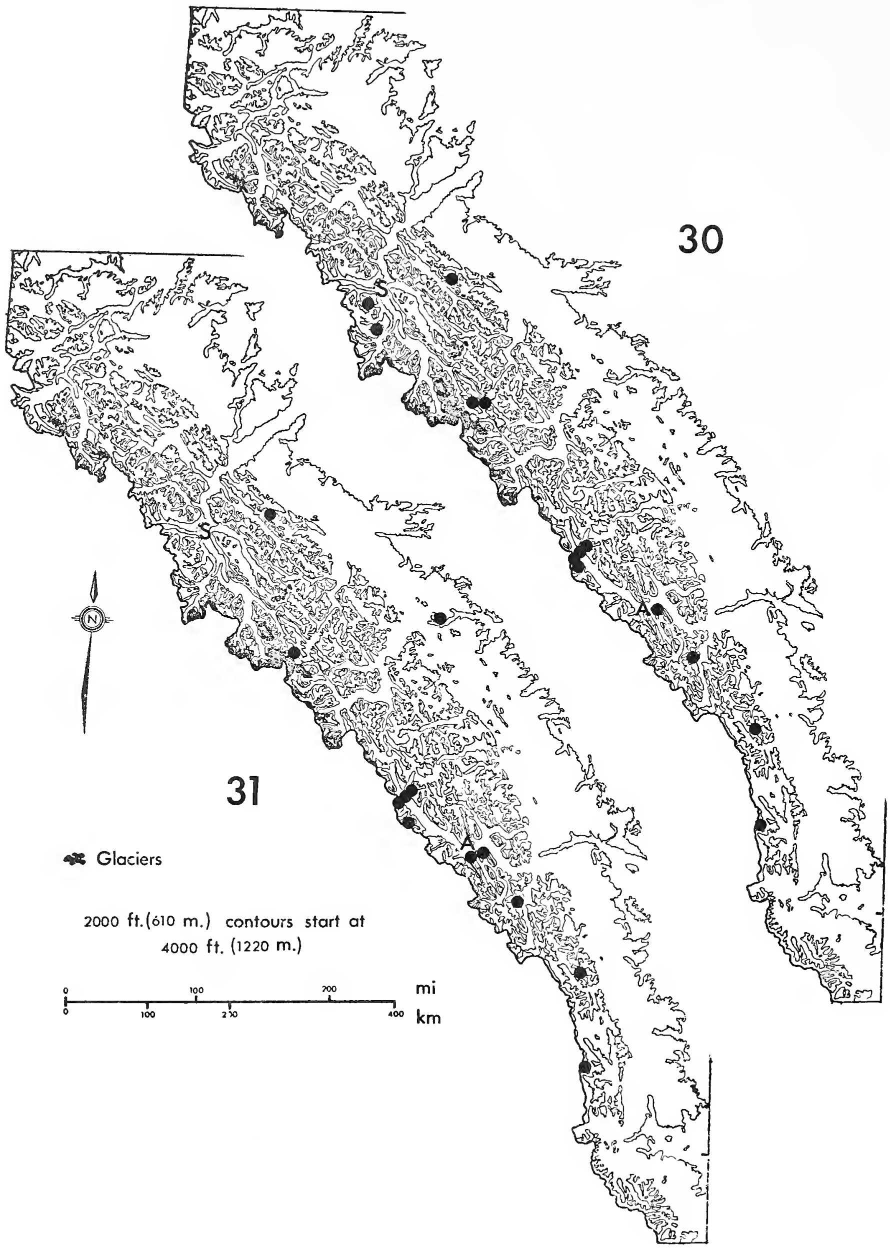
Figs. 24–25. Distribution of butterfly subspecies in Alberta.
A–Banff; S–Jasper. Fig. 24: *Colias nastes streckeri.* Fig. 25: *Lycaena phleas arethusa.*



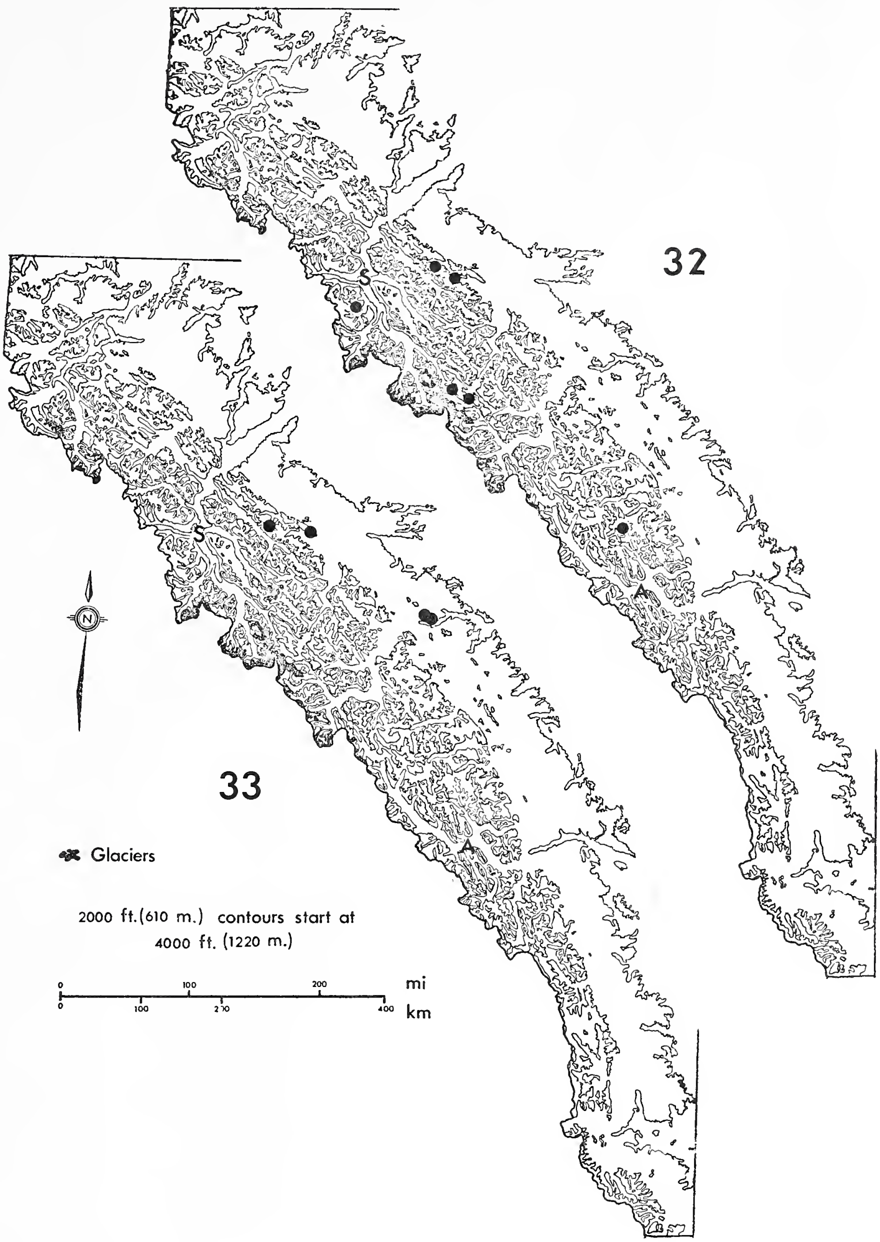
Figs. 26–27: Distribution of butterfly subspecies in Alberta.
A–Banff; S–Jasper. Fig. 26: *Lycaena s. snowi.* Fig. 27: *Euphydryas editha beani.*



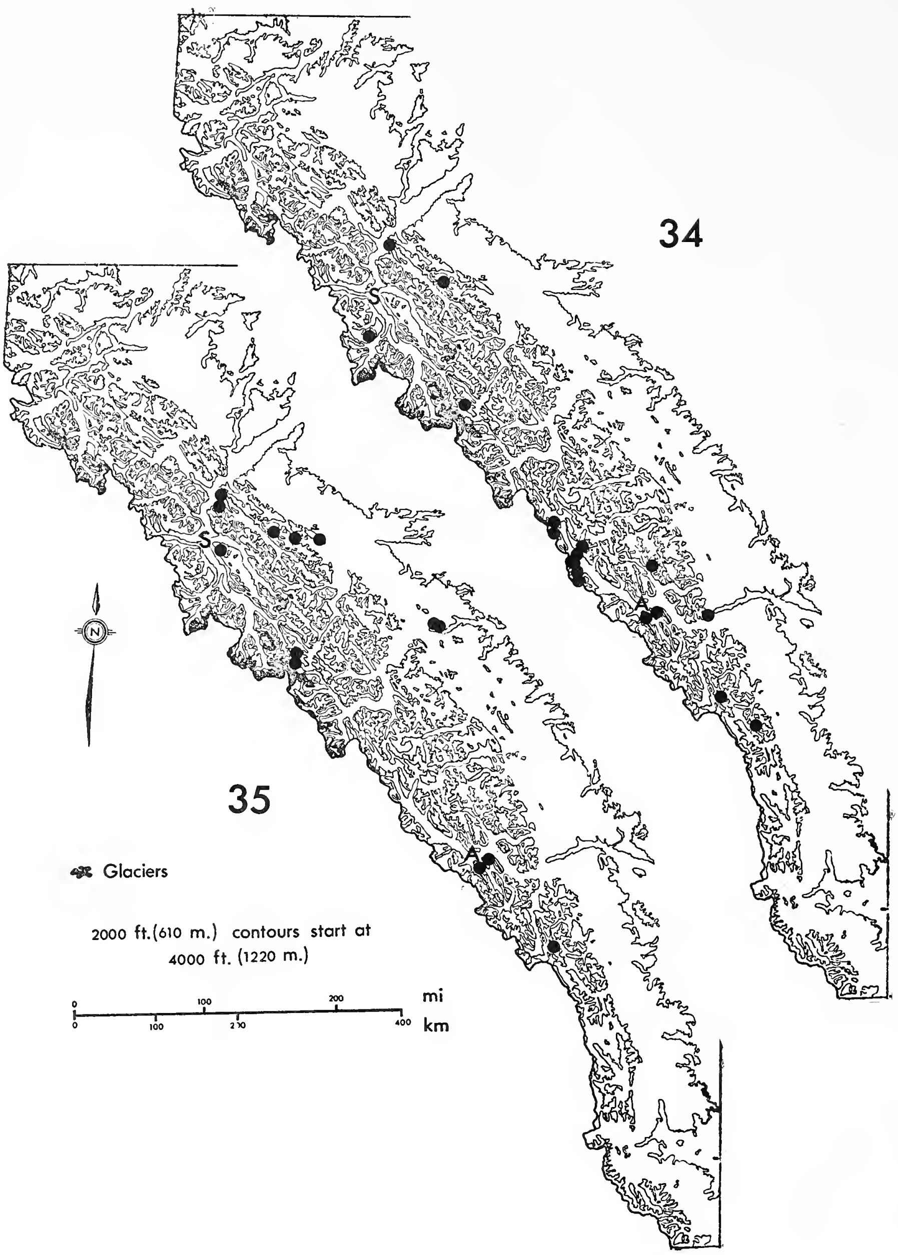
Figs. 28–29. Distribution of butterfly subspecies in Alberta.
A–Banff; S–Jasper. Fig. 28: *Boloria napaea reiffi*. Fig. 29: *Boloria improba youngi*.



Figs. 30–31. Distribution of butterfly species in Alberta.
A–Banff; S–Jasper. Fig. 30: *Boloria alberta*. Fig. 31: *Boloria astarte*.



Figs. 32–33. Distribution of butterfly subspecies in Alberta.
A–Banff; S–Jasper. Fig. 32: *Boloria eunomia nichollae*.Fig. 33: *Oeneis bore edwardsi*.



Figs. 34–35. Distribution of butterfly subspecies in Alberta.
A–Banff; S–Jasper. Fig. 34: *Oeneis melissa beani*. Fig. 35: *Onenis polixenes brucei*.

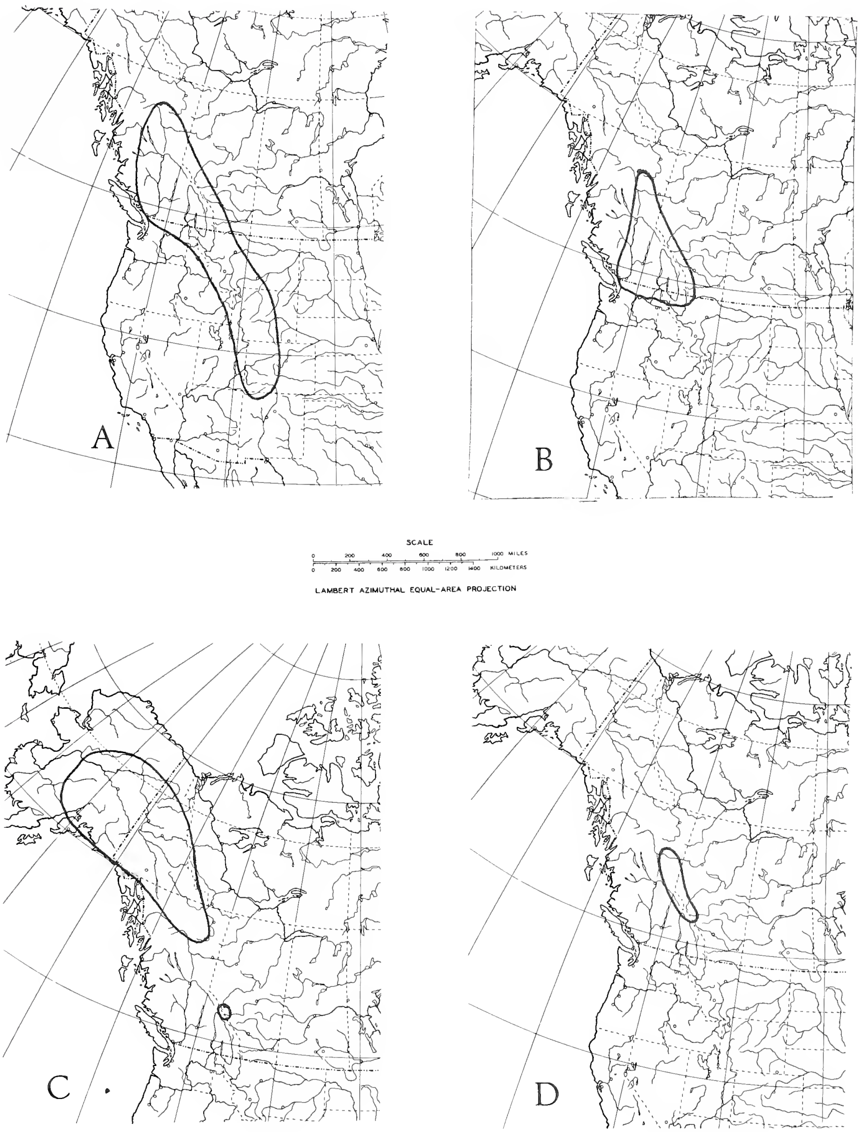


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Fig. 36: Distribution types exhibited by Alberta tundra butterflies.
A–Southern Montane; B–Central Montane; C–Disjunct populations; D–Endemic forms.

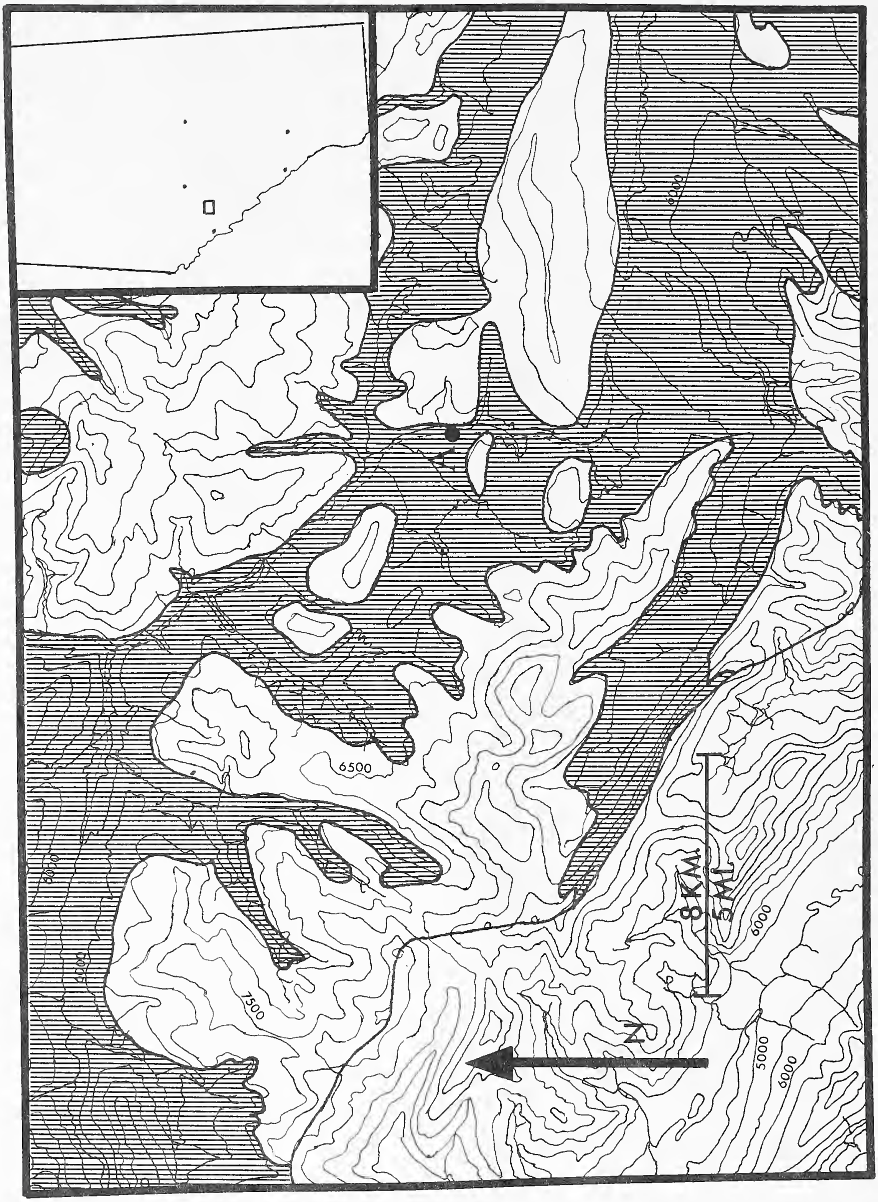

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Fig. 37: Extent of early Wisconsinan ice in the Mountain Park area. Hatching indicates presence of ice. Note extensive unglaciated areas above 6500 feet. Modified from data in Reimchen and Bayrock, 1977. The location of the town of Mountain Park is indicated by dot "A".

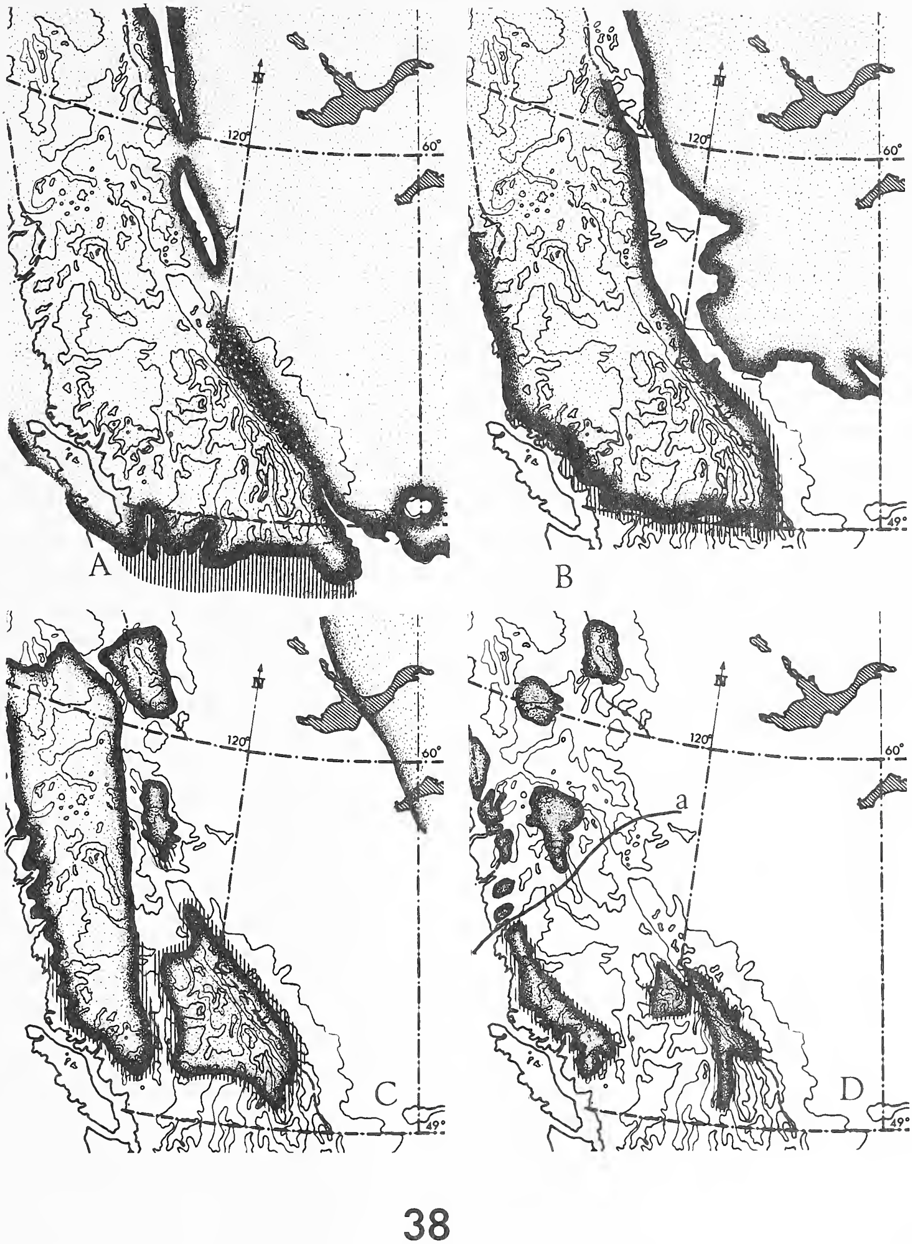

Fig. 38: Retreat of Wisconsinan and recent ice sheets in Western Canada modified after Prest (1969).
A–17,000 to 15,000 years before present; B–12,000 years before present; C–10,000 years before present; D–8,000 years before present.
Stippled areas correspond to continental ice sheets. Colonization of Alberta by taxa in the refugium south of the ice sheets is indicated by vertical hatching. In C and D this tundra would be very narrow, perhaps less than 1 kilometer. In D, line 'a' indicates limit of northern dispersal.

MATING AND NESTING BEHAVIOR OF EURYSTERNUS (COLEOPTERA: SCARABAEINAE

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ABSTRACT

Mating and nesting behavior of Eurysternus caribaeus, magnus and balachowskyi *show features which distinguish them from other scarabaeines and which collectively define a distinct group of nesting behavior designated Pattern VI by Halffter (1977). These distinguishing features are: a) the "nuptial feast", a massive formation of dung balls by the female initiating nesting; b) partial consumption and abandonment of these balls by the parent(s); c) lack of ball-rolling; d) multiple nests, comprising several brood balls; e) nest care by the female; f) in some species, formation of a pair bond while nesting is in progress; g) destruction of some or all brood balls after a period of nest care (such nests are termed experimental nests); h) repetition of experimental nesting with intermittent periods of feeding until a final, or definitive nest is constructed and cared for until the emergence of progeny. Balls are made only by the female and only during nesting behavior; they are not made for feeding, although some may be consumed.*

Histological study of the ovary of E. caribaeus *suggests that attack and abandonment of an experimental nest is linked to continuation of oöcyte development during the period of nest care. Disparity between ovarial function and nest care (which represents a fault in the normal K-strategy of scarabaeines) is evidently what provokes the attack and abandonment of a nest after several days of intensive care.*

Nesting behavior of E. foedus *and an unidentified Mexican species are not like that of the species studied. Rather, their behavior is like that of certain* Onitini, *and is assignable to Group I behavior (*sensu *Halffter and Matthews, 1966).*

RESUMÉN

En este trabajo se presenta el comportamiento en la reproducción y la nidificación de tres especies de Eurysternus: E. caribaeus, E. magnus y E. balachowskyi *discutiéndose las características comunes a estas tres especies y a* E. mexicanus, *así como sus diferencias.*

El comportamiento reproductor de las cuatro expecies antes mencionadas tiene rasgos muy particulares que lo separan claramente de las pautas seguidas por los demâs Scarabaeinae, lo que llevô a Halffter 1977 a constituir el llamado grupo VI dentro patrones de nidificación de la subfamilia. Estas características peculiares han quedado confirmadas y ampliadas por este trabajo. Las mâs importantes son:

1. *Una secuencia en la nidificatiôn que se inicia con la formación masiva de bolas por la hembra (festîn nupcial), durante la cual o inmediatamente después ocurre la cópula; el festîn nupcial es seguido por la preparación de un nido múltiple (con varias bolas-nido) en forma de crâter que - en la mayor parte de las especies- después de un periodo de cuidados es atacado por la propia madre y abandonado (nidificación experimental) o cuidado hasta la emergencia (nidificación definitiva). Cuando se presenta nidificación experimental, al primer nido abandonado puede suceder el nido definitivo o bien varios nidos experimentales hasta llegar al definitivo, que en* E. balachowskyi *es de construcción distinta al experimental. Los nidos definitivos son cuidados hasta la emergencia de la progenie.*
2. *Sólo la hembra hace bolas y únicamente en relación con el proceso reproductor. No hay rodaje de las bolas.*
3. *Asociamos el ataque y abandono de las bolas (basândonos en el estudio histológico del ovario de* E. caribaeus, *a una continuación del desarrollo y maduración de oocitos durante el periodo de cuidados del o los nidos experimentales, fenômeno que no se presenta en los otros Scarabaeinae estudiados, cuyo comportamiento incluye cuidados prolongados al nido y cese de la oviposición. Este desajuste entre el funcionamiento del ovario y los cuidados al nido (ecológicamente una falla en la estrategia K típica de los Scarabaeinae) es el que consideramos que provoca, después de varios días de cuidados intensivos, que las bolas-nido vayan siendo atacadas, hasta ser el nido experimental abandonado.*

Además de un estudio detallado de los cuidados y construcción de los nidos en las tres especies, el trabajo incluye una descripción preliminar del funcionamiento del ovario en E. caribaeus *y su relación con el comportamiento; la descripcîon de la formación de la pareja bisexual y del papel del macho en la nidificación; la descripción del mecanismo de cópula, incluyendo el papel de un curioso peine de sedas del âpice de las tibias anteriores del macho. También es estudiado el espermatóforo, comparándolo con los otros conocidos de Scarabaeinae, y otros aspectos del comportamiento: la oviposición, asî como despliegues de agresión y limpieza, y varias pautas interesantes directamente relacionadas con la peculiar disposición de las patas medias y de las partes laterales del pronoto, que permiten un particular desplazamiento del animal boca arriba, así como el retoque y cuidado de las bolas, haciéndolas girar el animal boca arriba entre las patas anteriores y posteriores.*

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INTRODUCTION

Mating and nesting bevavior of adult *Eurysternus*, of the monobasic tribe Eurysternini, is unique in that it does not conform to described patterns for other Scarabaeinae (Halffter, 1977). Reproductive behavior of these adults does not conform well to either of the two main lines of feeding and nesting behavior, the latter being interpreted as derivations of feeding

behavior. These lines are the burrowing scarabaeines (tribes Onthophagini, Oniticellini, Onitini and Coprini) and the ball-rolling scarabaeines (tribe Scarabaeini). The behavioral uniqueness of *Eurysternus* adults was pointed out by Halffter and Matthews (1966). They were unable to relate the pattern to other groups because of inadequate knowledge. Halffter (1977) created a special group, Group VI, based on his studies of *E. magnus* Laporte, *E. balachowskyi* Halffter and Halffter and *E. mexicanus* Harold, to accomodate *Eurysternus* in the evolutionary sequence proposed by Halffter and Matthews (1966). Group VI is characterized as follows: a) initiation of nesting process by elaboration of numerous balls by the female; b) partial consumption and abandonment of these balls; c) lack of ball-rolling; d) multiple nests (nests comprising several brood balls) of one or two types in the same species; e) nest care by the female alone; f) in some species, formation of pair bond while nesting is in progress; g) destruction of some or all brood balls after a period of care; h) repetition of ball construction with intermediate periods of feeding directly from an excrement mass without ball construction.

Certain morphological features of *Eurysternus* are directly related to reproductive behavior (Halffter and Halffter 1977). Both morphologically and behaviorally, *Eurysternus* is a group isolated from the two main evolutionary lines of Scarabaeinae, the burying scarabaeines and the ball-rolling scarabaeines. It originated in South America, from which it expanded into Central America and Mexico (Typical Neotropical Dispersal, *sensu* Halffter, 1964, 1976).

This paper describes in detail nidification and certain other behavior aspects of *E. caribaeus*, *E. magnus* and *E. balachowskyi*. Nesting behavior of these three species collectively shows a trend from more generalized to one progressively more complex. General aspects of *Eurysternus* behavior are covered in the description of *E. caribaeus*; only distinguishing features of the behavior of *E. magnus* and *E. balachowskyi* are considered.

Descriptions are based upon laboratory observations. We did not observe a *Eurysternus* nest in the field (most *Eurysternus* inhabit tropical forests). Halffter and Matthews' account (1966) of a nest of *E. magnus* observed in the field by H. F. Howden agrees with our laboratory findings; moreover, A. Martínez (in litt.) reports observing the nest of a South American species in the field which resembles those described here.

In all other known scarabaeines the nesting process is derived from feeding behavior. In *Eurysternus*, however, this relationship is not clear. Nidification behavior of adults of this genus is not related to their feeding behavior; moreover, it is not directly derivable from that of either the Scarabaeini or burying groups.

In all observed species (the 3 studied here plus 4 others) ball making has not been observed outside the nesting process; that is, balls are fashioned only in a reproductive context. Moreover, even though *Eurysternus* adults are capable of making balls, they cannot roll them with the legs in the scarabaeine manner; if moved at all, they are butted along with the head. The facts that balls are fashioned only for reproductive purposes, that they are produced in large number (during the "nuptial feast" and that they are not rolled by their makers clearly distinguish the behavior of *Eurysternus* adults from those of groups IV and V (Scarabaeini). Some, principally Australian Canthonines cannot fashion brood balls (Matthews, 1974); but all of them can roll pieces of excrement which are small enough and whose shape allows it. This observation would support the hypothesis that rolling was an evolutionary antecedent to ball making (Halffter and Matthews, 1966; Matthews, 1974); but it could also be considered an adaptation to special characteristics of the predominant type of dung in Australia, namely pellets of marsupials. In *Eurysternus*, however, the situation is diametrically opposed; rolling

capability of adults is lacking while ability to make balls is highly developed.

For all species of *Eurysternus* known to us, adults can feed directly from a source of excrement for as long as 200 days without fashioning balls, which are made *only by the female*. Their production signals onset of reproductive activity. As Halffter (1977) points out, the nidification process in *Eurysternus* comprises 3 stages: 1) nuptial feast; 2) experimental nesting; 3) definitive nesting. In all three species studied, the female can repeat the process three or four times under conditions which presumably preclude ecological restrictions. These species have exceptionally long adult lifespans for Scarabaeinae, which may exceed two years.

Eurysternus Behavior

E. caribaeus (Herbst)

All material upon which the following observations are based were field-collected in two neighboring localities in the Lacandon rain forest, Chiapas, Mexico: Chansayab-Lacanjá and Bonampak. *E. caribaeus* occurs from Formosa, Argentina northward to Honduras (Halffter and Halffter, 1977). All material studied came from more northern populations which could represent a distinct species or subspecies neither of which was formally decided by Halffter and Halffter, (1977) because of a lack of sufficient data on the intraspecific variation of the South American *E. caribaeus*. Distinctive features of populations from which study specimens came are the almost uniformly dark dorsal and ventral surfaces (some specimens show the spotted appearance of typical *E. caribaeus*) and somewhat shorter average length.

Elaboration of balls, the nuptial feast. – The nuptial feast begins suddenly with rapid construction of a large number of balls by a female. We suppose that its initiation is linked to developmental state of the ovary. *E. caribaeus* females construct two to four balls within three or four days after emergence when oöcytes have barely begun to develop. Nevertheless, construction stops very quickly.

Once the nuptial feast has begun, the female is soon joined by a male. If a male does not arrive, the process is interrupted; we did not observe a nuptial feast completed by females isolated from males. Moreover, except for premature initiation of nidification (as mentioned above) females do not make balls if they are maintained in the absence of male contact.

Balls are made rapidly during the nuptial feast in the following fashion by *E. caribaeus* females; work begins in the lower part of the dung mass using the head and front tibiae while the middle tibiae are extended upward or rested on the dung and the posterior tibiae are rested on the ground or dung. A female enters a dung mass and separates a dung ball (Fig. 1) using the middle legs like oars to move herself in a manner unique to *Eurysternus*. From an upside-down position the middle legs are moved anteriorly beneath the dorsal surface while the tips of the tibiae are planted. Thus, the tips serve as support points for forward movement of the entire body. Such movement of the tibiae is permitted by the rounded shape of the pronotum (Halffter and Halffter, 1977). This "rowing" movement has also been observed in females of *E. magnus* and *E. balachowskyi*.

Once the ball is separated, the female begins another from within the cavity resulting from construction of the first, or to one side of it. Formation of each ball takes about 50 minutes; females of all three species, make balls continuously. Nevertheless, interruptions of up to several days can occur, after which a female resumes ball fabrication. Such interruptions cause marked variation in number of balls produced and duration of ball making (see Table 1).

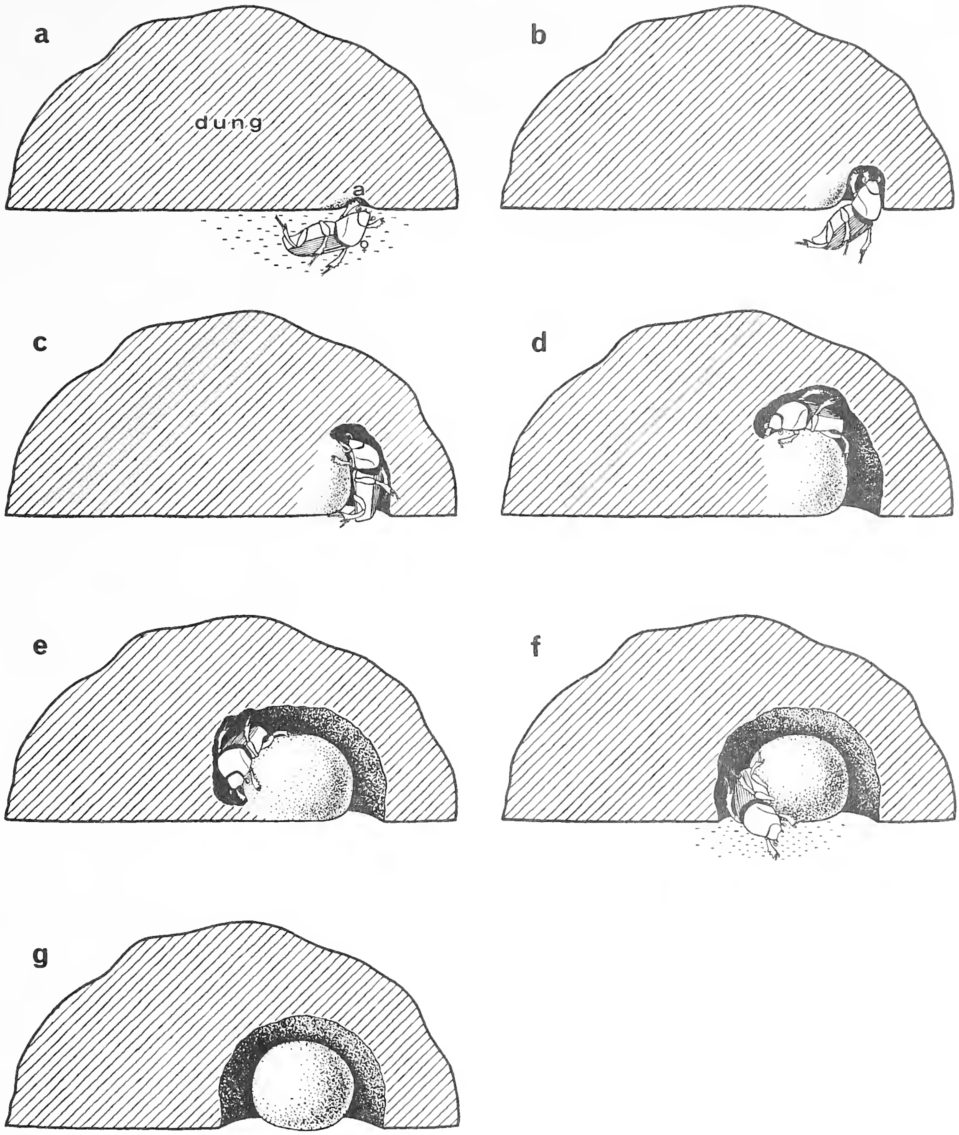


Fig. 1. *Eurysternus caribaeus* Hbst.. *a-g*: successive stages in the elaboration of a ball during nuptial feast

Balls produced during the nuptial feast are not exactly spherical nor uniform in size. Although eggs may be laid in from two to five of them by females of *E. caribaeus*, most balls are without eggs.

When a female has been deprived of male contact, she may begin ball making but the number does not exceed four. Production of many balls requires presence of a male, as does completion of the nidification process.

During the nuptial feast, both sexes of all three species eat directly from the dung source or from balls fashioned by the female, most of which are partially consumed and later abandoned.

TABLE I

COMPARISON OF ASPECTS OF NESTING BEHAVIOR OF THREE SPECIES OF

Eurysternus

ASPECT	SPECIES OF Eurysternus		
	E. caribaeus	*E. magnus*	*E. balachowskyi*
A[1]	16- 94, $\bar{x}$ = 34.5	9- 11, max.= 17	max.= 55+ 31- 50, during expt. nesting.
B[2]	7- 69, $\bar{x}$ = 29.8	12- 28	60- 90
C[3]	65- 80	not observed	not observed
D[4]	13- 82	1	continuous
E[5]	2- 6, $\bar{x}$ = 4.2	3	
F[6]	38- 53	25- 26	40

[1] Number of balls made during the nuptial feast.

[2] Duration of the nuptial feast (in days) from the making of the first nesting sequence, during which ball-making may continue interrupted or not.

[3] Duration of copulation, in minutes.

[4] Period (in days) between the end of the nuptial feast and beginning of next nest.

[5] Final number of balls in the definitive nest.

[6] Duration (in days) of the definitive nest.

Ovary development and behavior. – As is true for females of all Scarabaeinae (Halffter and Lopéz, 1977), the ovary of a *Eurysternus* female consists of a single ovariole (on the left side). The ovaries of *E. caribaeus* females possess two characters which are unusual to scarabaeines, particularly to those with advanced nidification: 1) the adult emerges with a completely developed germarium and 2) oöcyte maturation begins very soon and is rapid. It appears contradictory that even when a female is provided necessary male company (in a terrarium), the nuptial feast does not begin for at least 20, and as many as 50 days thereafter. Moreover, an additional delay results from the nuptial feast itself and periods during which it may be interrupted. Why there is such a long delay in egg production in spite of the ovarial condition of a newly emerged female may be explained by a prolonged period of vitellogenesis, which is much longer and morphologically more elaborate than in any of the few other scarabaeines females studied (Fig. 2).

The fecundity of *Eurysternus* females more nearly approaches that of a scarabaeines with primitive nidification, such as *Onthophagus*, than that of one with more advanced nidification. This high fecundity may explain destruction and abandonment of experimental nests to begin a new nest (*E. caribaeus*, *E. balachowskyi* and *E. mexicanus*). High fecundity is perhaps also the explanation of frantic formation of balls during the nuptial feast, most of which are not used. In addition, the following ecological fact may obtain: the high number of balls may serve to compensate for losses through robbery by ball-rolling scarabaeines, losses which should be important during fierce competition for excrement within tropical forest.

Upon emerging, the germarium of *E. caribaeus* is completely developed (Fig. 2-a) but does not contain developing oöcytes. Three days after emergence, two developing oöcytes and two nascent ones are at the base of the germarium (Fig. 2-b). Such a rapid development of oöcytes is completely out of the ordinary for scarabaeines. Nineteen days after emergence, still before beginning the nuptial feast, the ovariole bears 6 oöcytes (Fig. 2-c), within the most mature of which are lipid globules while at the same time the germarium is reduced.

The nuptial feast begins a few days later when the ovariole contains a series of oöcytes of which the first ones are mature. During the feast (the function of which appears to be attraction of a male) copulation can occur at any time. Figure 2-d illustrates an ovary of a female during the nuptial feast immediately after copulation: four oöcytes contain large quantities of granules; the fifth and sixth are forming. During this stage as many as eight oöcytes in various stages of development are distinguished.

If a male is present, the nuptial feast develops; if copulation occurs, some days later (depending upon the state of maturation of the ovary) *nidification continues.*

We suppose that destruction and abandonment of brood balls in experimental nests are due to continuation of oöcyte formation. Whatever the mechanism is in other scarabaeines (Halffter and Lopéz, 1977) which, in concert with ovarial development, determines female behavior and which, in turn (according to the phase of reproductive behavior) inhibits the ovary, it does not function in *Eurysternus*. Unlike other groups with complex nidification (Groups II, III and V, Halffter, 1977), the ovary of a *Eurysternus* female continues oöcyte production, she continues ovipositing in new brood balls and simultaneously attacks or abandons those which were being cared for.

We suppose that these continuous processes end with completion of the first series of oöcytes, at which time the female ceases destruction and initiates care of what will be the definitive nest.

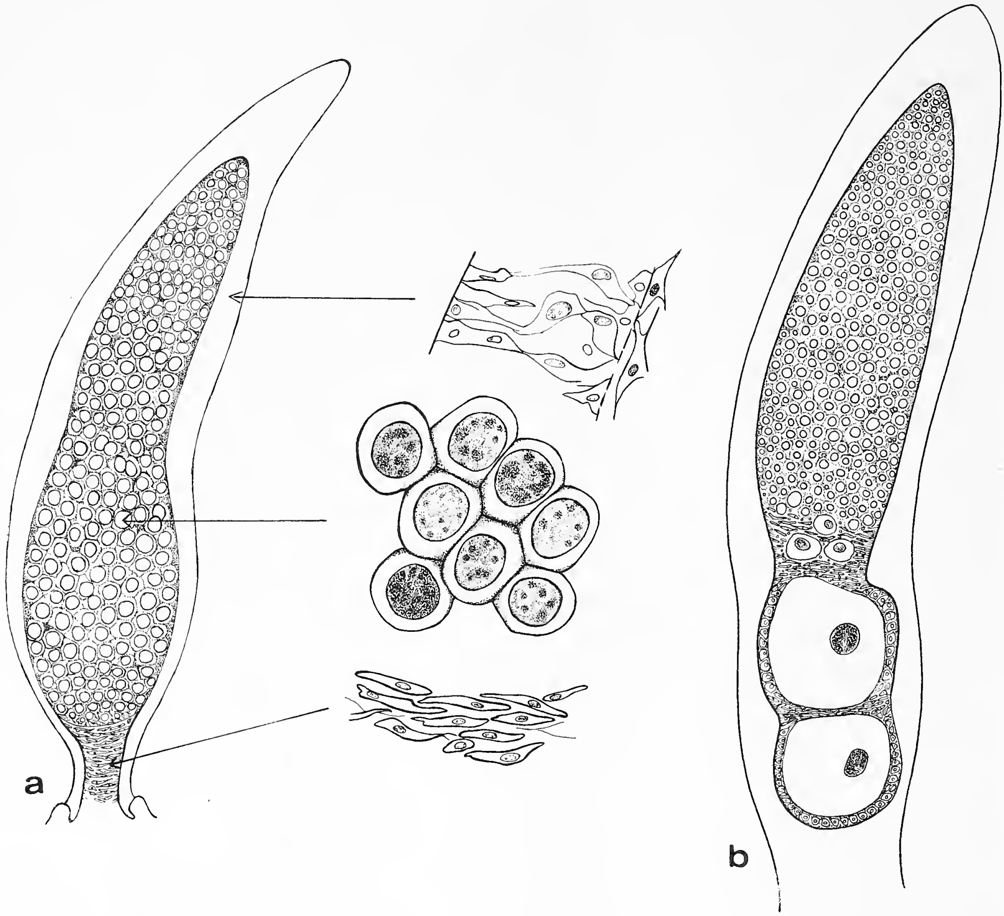
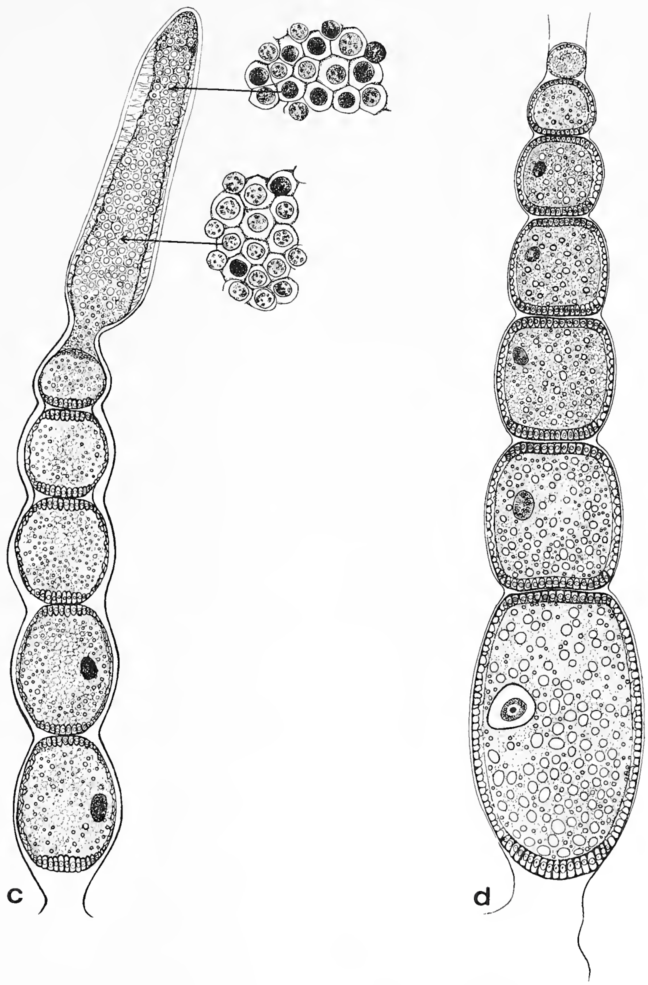


Fig. 2. Development of ovary in *Eurysternus caribaeus* Hbst.*a:* One day after emergence, there is no differentiation in germarium formed by cells with very pigmented nucleus (trophocytes) and cells with nucleus less pigmented (oöcytes) - see detail; other details indicating the tunica propia and the inner and outer layers, as well as the mass of prefolicular cells; *b*: three days after emergence - two oöcytes in vitellogenesis, several in initial process of development in the base

During care of the definitive nest (Table 1), a new series of oöcytes matures in females of *E. caribaeus*. Toward the end of care, the ovary resembles that observed in the midst of the nuptial feast. Copulation may occur at this time and a second nidification process begins immediately after termination of the first (even before emergence of offspring) without an intermediate feeding period.

Variability of duration of the nuptial feast as well as timing of copulation explains why eggs are in some (but few relative to the total) balls of the nuptial feast of *E. caribaeus*. This indicates that the first oöcytes can mature before the end of the feast, at least under laboratory conditions. We do not know if in the field, under conditions of intense competition, prolonged nuptial feasts are possible without balls being robbed.

Formation of the bisexual pair. – In all three species studied, a male joins a female during the nuptial feast in the midst of ball formation. As in *Phanaeus*, (Coprini; Halffter, Halffter,



of germarium; *c*: 30 days after (before the beginning of nuptial feast - development of the vitellarium, in the germarium, trophocytes tend to concentrate in the apical extreme; *d*: vitellarium 45 days after emergence, in the middle of the nuptial feast, immediately after copulation - the more mature oöcytes are close to oviposition.

and Lopéz, 1974) but unlike Scarabaeini, a female's activity attracts a male. In *Eurysternus*, formation of brood balls acts as an attractant for a male.

In *E. caribaeus*, the pair remains intact only during the nuptial feast. In *E. magnus* and *E. balachowskyi*, pairing is maintained through experimental nidification. Most females of all three species are alone during preparation and care of the definitive nest. Nevertheless, in *E. caribaeus* we have seen copulation in a definitive nest during the period of care. This copulation is part of the second nidification process to follow and likely owes its occurrence to conditions within the terrarium, which prevent the male from leavingy and favor encounter with the female during maturation of the new series of oöcytes. In the field a female may encounter another male upon beginning a new nuptial feast after emergence and dispersal of her offspring and an intermediate feeding period.

Copulation. – Normally in each reproductive cycle a single copulation occurs during the nuptial feast (among the balls or at the side of the dung mass, Fig. 3). It may also occur a second time during care of the definitive nest or during the last phase of care of the definitive nest in *E. caribaeus*, but when it does it results in abandonment of the nest and initiation of a new nidification process. In *E. caribaeus*, the male approaches the female from behind and mounts her while tapping her elytra with the front legs while supporting himself on the ground with the hind legs. The middle legs are held extended dorsolaterally. Meanwhile, the female remains quiet and continues feeding. In a few minutes, the male has situated himself horizontally over the female (Fig. 3) while grasping her abdomen with his back legs, the tibiae of which are curved to facilitate hanging on. (To different degrees, this curvature of the hind tibiae is a secondary sexual feature of all male *Eurysternus* studied). Meanwhile the middle legs remain extended while the anterior legs softly caress the pronotum. At this moment, the aedeagus is extended but not yet engaged in the female genital opening. The female, which up to now had remained quiet, begins a series of movements which result in the pair being upside down or lying on one side. The male remains strongly attached while continuing to caress the female. When the female ceases movement, the male introduces the aedeagus and inserts the internal sac.

The female remains quiet 30 to 45 minutes before resuming her movements. The male remains astride her but disengages the internal sac and withdraws the aedeagus. The female finally succeeds in separating herself from the male using strong movements. Observed copulations have lasted 65 to 80 minutes.

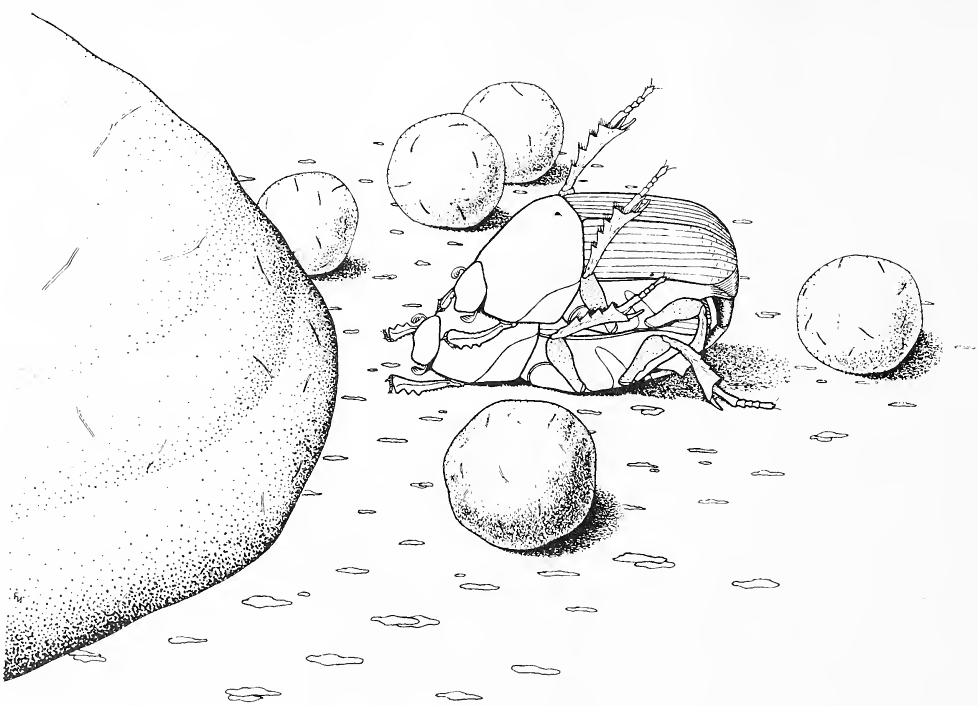


Fig. 3. *Eurysternus caribaeus* Hbst. Copulation during nuptial feast.

Fig. 4. *Eurysternus caribaeus* Hbst. Spermatophore immediately after its deposit in vagina.

Halffter and Halffter (1977) describe a curious lobe bearing a comb of setae on the apex of the male tibia. They believed the structure to somehow be related to the fact that a male sometimes cares for brood balls; that is, that the combed lobes were used to clear or otherwise retouch the brood balls. Such now appears not to be so. The structures appear to be important to *stimulation of a female* during copulation. This is the first structure of scarabaeines directly and clearly related to sexual stimulation. Although similar stimulation appears characteristic of scarabaeines in general, *Eurysternus* is the only group with a special morphological modification which complements it, although males of several *Onthophagus* have a tuft of setae at the apex of the anterior tibia.

In *E. caribaeus* the spermatophore is a very long, translucent tube containing spermatozoans (Fig. 4). The ovoid shape of the compacted tube suggests a circular movement during ejaculation with a gradual retraction of the free tip of the internal sac. This movement occurs in spite of the spines of the internal sac which contact the sclerites of the wall of the vagina. The few spermatophores known for other species have different forms indicating a different movement during deposition (Heymons, 1930; Huerta, 1977; Halffter and Lopéz, 1977).

The spermatophore occupies more than half the vagina. Form of the spermatheca, spermathecal muscle and spermatozoans suggest that insemination follows a process like or very similar to that observed in *Phanaeus* (Halffter and Lopéz, 1977).

When copulation is complete, the crater-like nest is not immediately begun. Since copulation can occur at any time during the nuptial feast, the time between copulation and

crater construction varies. Moreover, some balls made during the nuptial feast are provided with eggs. Thus, relatively rarely, copulation and complete maturation of some oöcytes begins so early that some balls receive eggs during the nuptial feast. The chances that these eggs later develop are remote since most are destroyed by the parents or left uncared for.

Nidification. – The nuptial feast is followed by experimental nesting which is not as distinct an event in *E. caribaeus* as in *E. balachowskyi.*

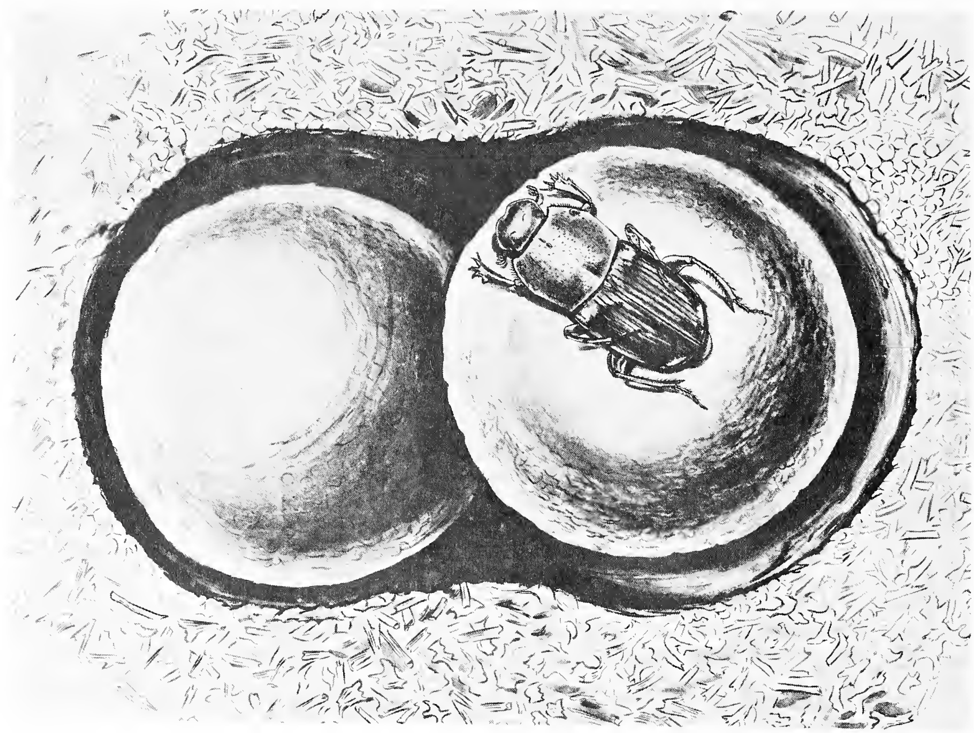


Fig. 5. *Eurysternus caribaeus* Hbst. Female caring for definitive nest.

In *E. caribaeus*, experimental nesting is represented by those beginnings of craters and brood balls which are abandoned by the female. Experimental nests occur in 65% of observed cases; 35% of observed nidification by *caribaeus* included no experimental phase.

Definitive nesting.. – Preparation of a definitive nest is strictly linked to state of the ovary; its timing corresponds with maturation of the last oöcytes of a single series. (Recall that the life of a female may, however, include several series). We believe that nest destruction is inhibited by and continuous care maintained by, an interruption in maturation of oöcytes. Conversely, nest care behavior acts as a temporary inhibitor of oöcyte maturation. Evidently female behavior changes during definitive nesting such that ball destruction and abandonment are not manifested.

In *E. caribaeus*, nidification (definitive or experimental) begins 13 to 82 days after the end of the nuptial feast. This variation is due to differences in the timing of copulation and maturation of oöcytes.

The definitive nest of *E. caribaeus* is a crater dug by the female, beneath several previously fashioned balls; several other balls may be pushed into the crater. Initially, the crater contains seven to 12 (average 8.7) balls, of which two to six (average 4.2) remain in the completed nest. The latter are provided eggs and an external layer of soil.

To prepare the definitive nest a female uses the last balls made during the nuptial feast. They receive final modelling, which results in their being larger than balls constructed previously (seen also in *E. magnus*). The balls are slightly increased in diameter as the nest develops. The average diameter of balls containing eggs is 23.9 mm; that of balls containing larvae, 24.7. This increase is produced by the larva by its continual repair to the internal surface using its excrement without breaking the wall and the action of the mother on the outside surface.

In the definitive nest, brood balls are carefully modelled and covered with a layer of soil, which often binds two to four balls into a single, compound structure (Fig. 6).

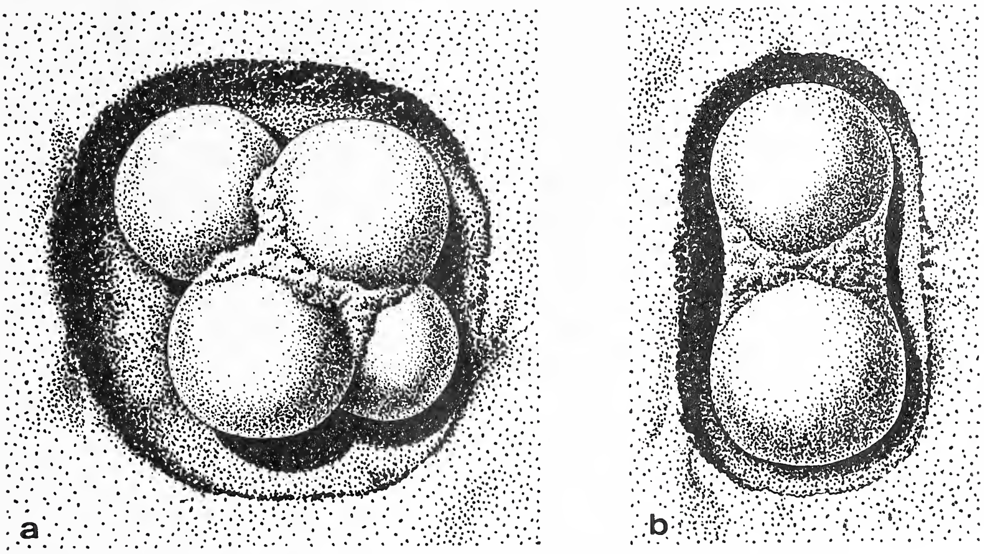


Fig. 6. *Eurysternus caribaeus* Hbst. Types of definitive nest. Observe the union of brood-balls with soil.

Nest abortion, or cessation of care and abandonment or attack of balls occurs before the soil layer is added. Protection of the soil layer is ended when the larvae reach the third instar.

Nest formation is not rapid since it includes much modelling and remodelling and spaced oviposition. Thus, a single nest may include balls with eggs and other with larvae in all stages of development. Toward the end, development stages among progeny tend to become equalized.

As a nest develops, a female may depart for several hours to feed, but she returns. She cares for brood balls in the definitive nest until emergence of new adults. A male does not participate in nest care; normally he is not present. The nest crater can be to the side of the dung mass from which the brood balls were extracted or beneath it. If beneath, the nest crater is hemispherical. Definitive nesting lasts 38-53 days, during which a female maintains constant care. If copulation occurs during the care period, within a few days after emergence of progeny the female begins a new nesting cycle by initiating a new nesting process.

Lapse of time between two nests depends upon whether or not copulation occurs during care of the definitive nest. One female, which had copulated 20 days previously, began a new nidification beneath the nest she was caring for. At the time the nest balls contained pupae, whose care she abondoned (Fig. 7). The new nest was not finished.

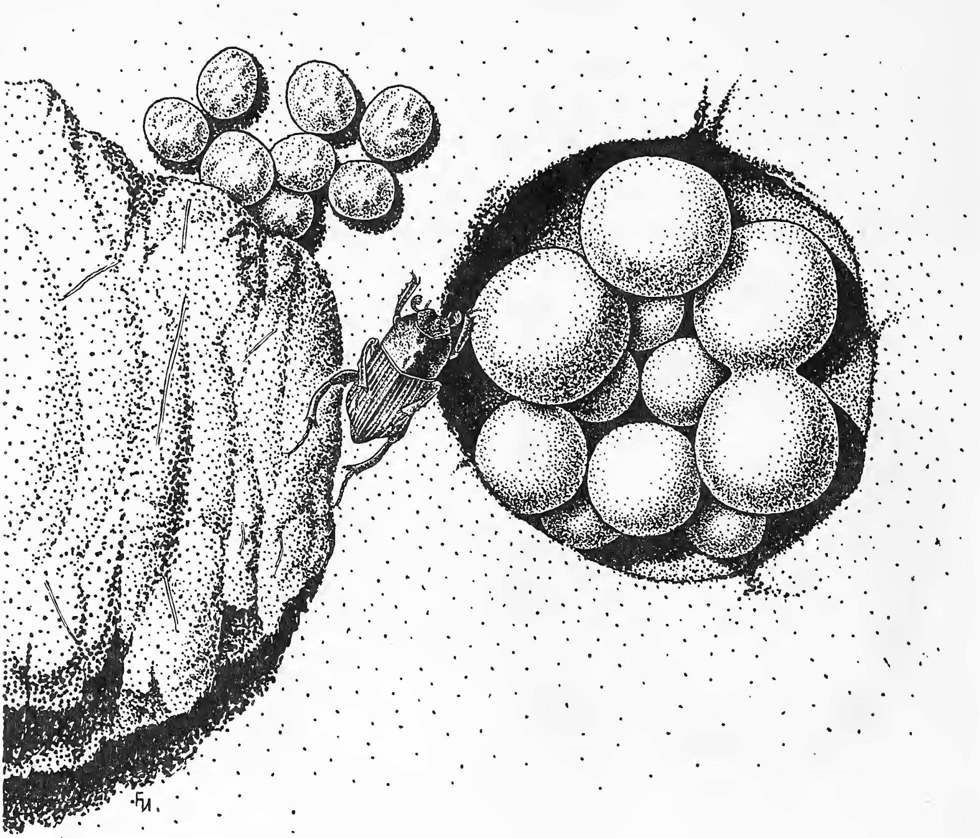


Fig. 7. *Eurysternus caribaeus* Hbst. Exceptional case: in same crater two nests were superposed.

***Eurysternus magnus* Laporte**

Material upon which the following observations are based was collected at Lagunas de Montebello, Chiapas, an area of pine – *Liquidambar* forests at 1400 m near the Guatemalan border.

Cleaning. – The system of self-cleaning by *E. magnus* adults is probably used by those of the other two species studied. Dorsal surfaces of the elytra are cleaned with the middle tibiae and tarsi; apices, with the hind tarsi. All *Eurysternus* adults bear numerous ocellate punctures, each with a central seta, particularly on the pronotum. These punctures easily collect dry excrement and dirt, which normally cover part of the entire dorsum. "Dirty" appearance coupled with normally obscure brown or black coloration results in a rather striking cryptic coloration. Adaptiveness of the cryptic appearance is enhanced behaviorally by the habit of remaining motionless (thanatosis) such that *Eurysternus* adults are exceedingly difficult to see in their

natural surroundings. Presumably this cryptic coloration offsets increased vulnerability of these beetles resulting from the fact that they do not burrow like almost all other scarabaeines.

Ball construction, nuptial feast. – We have observed *E. magnus* adults feeding directly from dung for as many as 190 days. Some enter the dung mass superficially to eat. The nuptial feast begins suddenly as in *E. caribaeus*. Number of balls prepared varies from nine to 11; Maximum observed was 17. These balls are eaten, changed in position, destroyed and remodelled and only a small portion is used for nesting.

Balls are separated from the margin of the dung mass in contact with the ground. The female may separate the ball in an upside-down position using the front legs (cf. *E. caribaeus*). The margin of the dung mass presents concavities in places where balls have been separated. Balls are constructed rapidly but with little care until the dung mass is exhausted. Rhythm of construction is not uniform but is continuous. Fresh balls are only roughly spherical, not smoothed over and with an approximate diameter of 15 mm. During intensive ball-making, some are moved randomly on occasion (up to 9 cm) by pushing with the head and forebody while planting the front and hind legs. Pushing is not continuous, but rather is achieved by a series of butting motions.

Nesting. – Definitive nesting occurs from 12 to 28 days after beginning the nuptial feast. Females of *E. magnus* do not construct experimental nests. The nuptial feast is followed by the excavation of the nest crater, which is not destroyed, as are 65% of the nests of *E. caribaeus* and all nests of *E. balachowskyi*.

A nest is begun with balls from the nuptial feast, which are remodeled superficially by adding excrement. The crater is dug beneath three of these balls; excavation requires a day. The finished crater is shallow, circular and about 5 cm in diameter (diameter of the rim is somewhat less than that of the floor). The day after finishing the crater, about three more balls are pushed into it. Thus, at first the nest contains more balls than will be converted into brood balls, generally three (Fig. 9). The extra balls are used for food, to finish the brood balls or simply taken apart.

A few hours after finishing the crater, a female models or retouches the balls and begins oviposition even though all balls will not receive eggs. Two days after nesting is begun, a female begins adding soil cover to the balls; this activity lasts as long as seven days. After oviposition and covering are completed, brood balls are cared for continuously throughout development of offspring.

As the brood balls are cared for, their positions are changed continously by pushing or, in an upside-down position, by making them turn using the front and hind legs from beneath or from the side (Fig. 8). The front tibiae are used to retouch and smooth their surfaces. Balls are cared for alternatively and continuously and are not joined with soil as in brood balls of *E. caribaeus* (Fig. 9). Although a ball may be attacked, the nest is not destroyed.

Once we have seen a male caring for brood balls, changing their position frequently while the female continued to fashion balls from the nearby dung mass until it was exhausted. Some of these balls were eaten, others simply abandoned. A male of *E. magnus* remains with a female during nest formation and during part of the period of care. Rarely a female and much more frequently a male may, for a short time, move to feed from a nearby dung mass before returning to the nest.

As in *E. caribaeus*, brood balls are increased in size during development. Balls constructed for the nuptial feast have an average diameter of 15 mm when formed from the dung source.

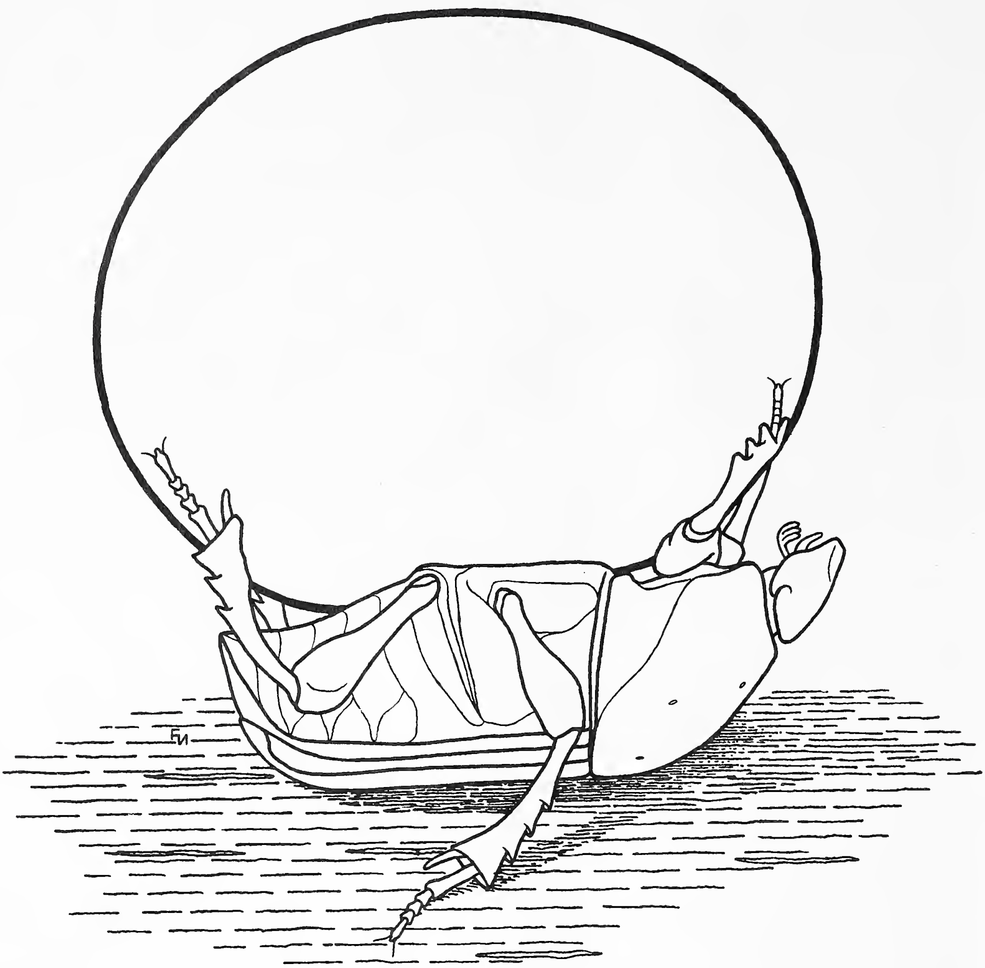


Fig. 8. *Eurysternus magnus* Laporte. Female turning nest ball in interior of crater.

After being remodelled (using fragments from other balls or from the dung source itself) the diameter exceeds 18 mm. The brood balls have an average diameter of 21 mm.

Subsequent nests of *E. magnus* are not constructed as rapidly as are nests of and *E. caribaeus*. About 170 days elapse between emergence of adult progeny and initiation of a new nuptial feast.

Oviposition. – We have observed oviposition in detail only by females of *E. magnus* but believe it must be similar in *E. caribaeus* and *E. balachowskyi*. Using her front legs, a female forms a hole in a prepared ball into which she enters almost completely and remains about five minutes. Afterwards, she withdraws, turns, and introduces her abdomen. For another five minutes, the hind legs are moved up and down while the middle legs rub the sides of the body. Oviposition is in the bottom of the cavity. The female then collects dung from the same ball to close the egg cavity using the front legs to work it into the opening as she turns around it. Oviposition lasts 25 minutes, after which the egg remains in a small central cavity.

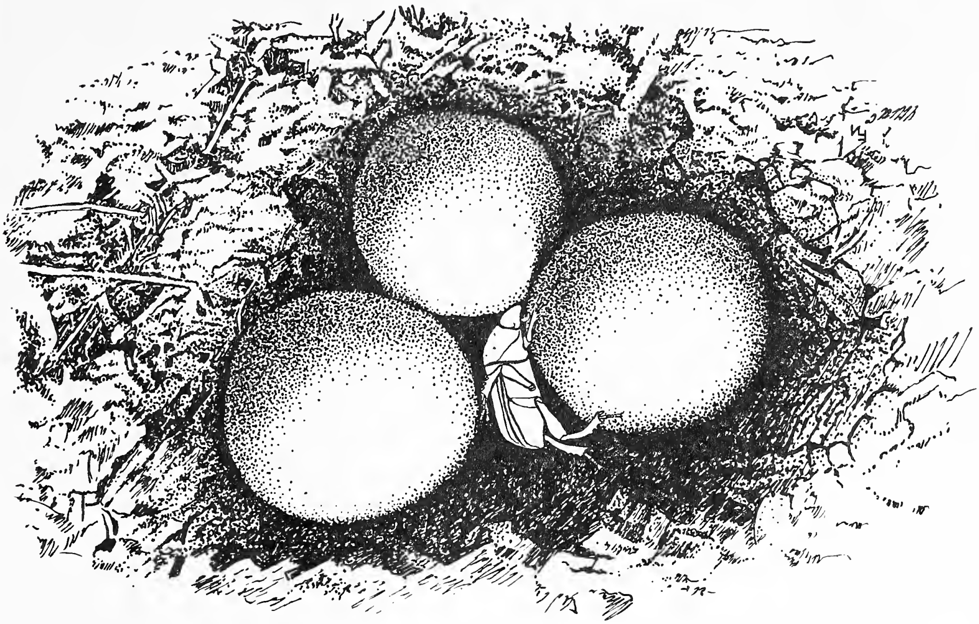


Fig. 9. *Eurysternus magnus* Laporte. Definitive nest. Observe balls are not united by soil.

***Eurysternus balachowskyi* Halffter and Halffter**

Observations are based on material from French Guiana (see Halffter and Halffter, 1977).

Ball-making, nuptial feast. – The nuptial feast of adults of this species is the largest (to 55 balls) and longest (to two or three months) of those species studied. Many of the balls are abandoned or partially consumed. No eggs have been found in nuptial feast balls. Although ball making is not suspended for more than a few days its rhythm is not uniform. Thus, for some days a female makes no balls, but on others she may make several.

Balls can be separated from the upper part of a dung mass and from there rolled to the ground. A female may work right side up or upside down, but either way she separates excrement *in small bits* which are molded into a ball. The front legs are used to incorporate and press the dung while the back legs, by making the mass turn between them, give the ball its spherical shape. The middle legs remain free to either support the body or to move it with oar-like movements as described for *E. caribaeus*.

Ball-making by *E. balachowskyi* females differs from that of *E. caribaeus* in that, rather than separating an entire ball from a dung mass in a single operation, it is gradually built up by fragments added to the growing ball by the front legs. Completed balls either accumulate to one side of the dung mass or they are pushed short distanaces. They are not exactly spherical; the lesser diameter varies between 15 and 18 mm while the greater varies between 15 and 20.

Some of the balls are retouched at one side of, or some distance from the dung mass. As balls are moved, they are grouped; some of each group are retouched. Some smaller balls are combined with larger ones, upon which the beetle perches as it pulls and incorporates the smaller with the front legs. Debris produced by retouching include small pieces of dung, small balls, including some already worked. The front legs press and smooth the surface of the ball;

later a thin layer of soil is added. Retouching includes spinning the ball with the front and back legs while the female is upside down.

At the end of the nuptial feast, some retouched balls receive eggs. The first oviposition begins the experimental nesting phase; during the nuptial feast (in the strict sense) no balls receive eggs.

Oviposition is followed by formation of a nest crater. In the other two species, crater excavation precedes or coincides with oviposition.

Experimental nesting. – For approximately 60 days after the nuptial feast, a female oviposits in a number of balls and constructs about three successive craters where the balls are placed and cared for a few days before they are attacked, partially consumed and abandoned.

In contrast to the other two species, the *female continues ball-making during experimental nesting (31 to 50 additional balls) if excrement is nearby.* Undoubtedly, this prolonged process of ball-making is related to destruction and abandonment of experimental nest craters. The nuptial feast, with its characteristic elaboration of balls, overlaps with experimental nesting, with its oviposition and formation of nest craters. This overlap we attribute to a continuously active ovary, which by not ceasing activity, fails to produce the metabolic signal that the nest should be cared for and ball-making ended.

Balls made during experimental nesting and at the end of the nuptial feast have two possible fates: some are abandoned, whether or not they contain eggs; others are taken apart and partially eaten, whether or not they contain eggs. Some eggs in balls removed from terraria develop; others do not.

Preparation of the nest crater is very similar to that of *E. magnus* and *E. caribaeus* females. Some balls are provided with a thin soil covering. As for *E. magnus*, the male of *E. balachowskyi* often remains with the female and can participate in care of the brood balls. Remodelling of the balls in the nest crater and their care is exactly as described for *E. magnus*. Within a few days, four or five well worked balls are in the nest crater; of these, three large ones finally remain and (rarely two) are completely finished and with eggs and a thin layer of soil. They are cared for by the female. About two days later, one of the balls is eaten by one of the parents, but the female continues caring for the others for approximately six days. During this time the female does not leave them but attacks and partially consumes some of them. Eight days after the first attack, most balls have been damaged by the parents and the nest crater is abandoned.

During the period a male or female may eat from a nearby dung mass (the attack is not occasioned by hunger) and, moreover, the female may make other balls which are pushed into the crater and ultimately destroyed. Some balls may by chance survive the attacks and the egg continues its development.

After a period of direct feeding, experimental nesting is repeated, generally three times, with the consequent abandonment of the nests.

Oviposition is similar to that by *E. magnus* females. Each egg is in a chamber near the upper pole of the brood ball closed by a plug of loosely compacted grass fibers. Oviposition can occur either on the surface, after massive ball-making, or in the nest-crater.

Definitive nesting. – The definitive nest of *E. balachowskyi* adults is different from experimental nests in both how it is made and in its final structure. Of the last balls made, two are separated for definitive nesting. This separation begins definitive nesting and occurs about five months after beginning of the nuptial feast and about two months after the first oviposition and experimental nest. The two balls selected have diameters exceeding 27 mm; they are placed

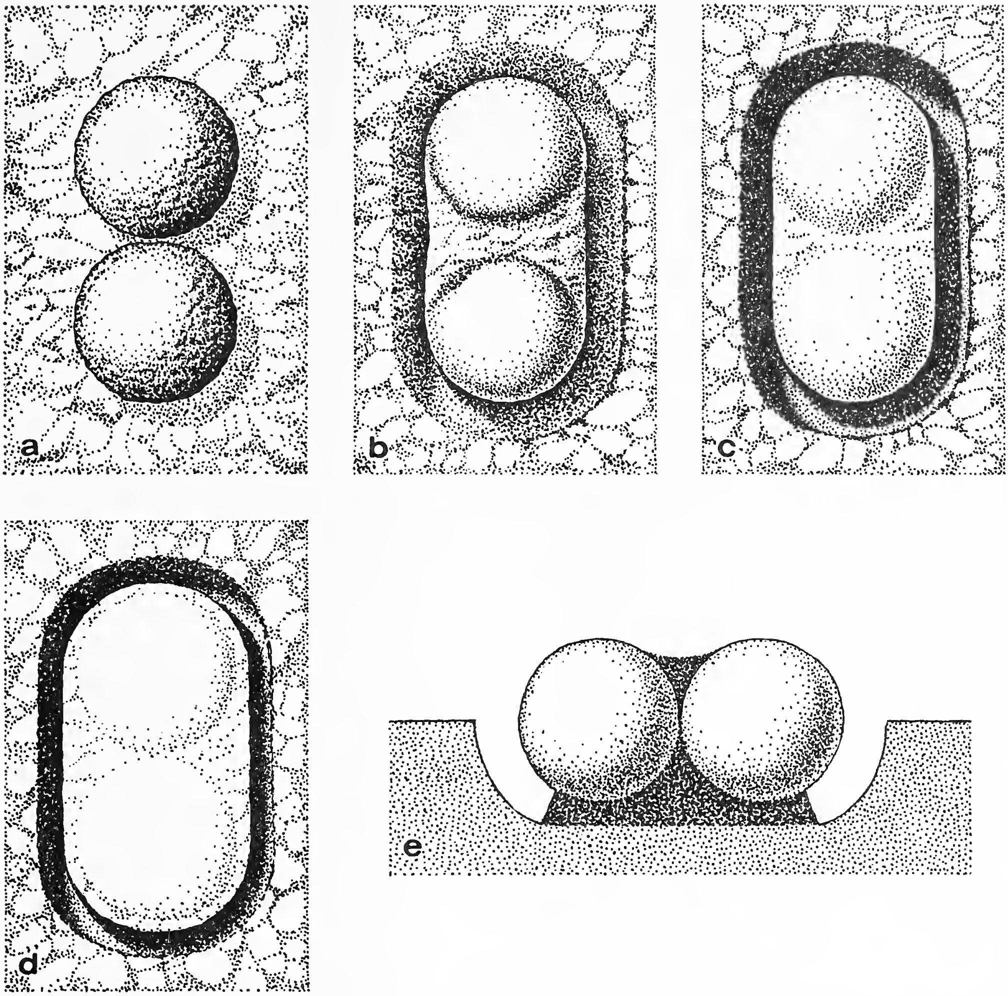


Fig. 10. *Eurysternus balachowskyi Halffter and Halffter.a-d*: stages in formation of definitive nest in dorsal view.- two brood balls united with soil and peripheral groove deepens; *e*: definitive nest cut transversely.

on the surface in contact with each other (see Halffter, 1977, Fig. 12) 15 to 20 cm from the dung mass and covered with soil. The female then excavates a groove around them (see Fig. 10) which is enlarged until the balls are in contact with a minimum of support. Maximum width of the groove is 7.5 cm; maximum depth, 3.5 cm (see Halffter, 1977, Fig. 13).

This nest is cared for by the female for about 40 days. She makes no attempts to destroy it but, rather, spends most of her time in the groove, cleaning and maintaining it. Development lasts about 43 days to teneral adult and another eight days to emergence. The female abandons the nest shortly before emergence and about a month later re-initiates a new period of ball-making. This 30 day period is about the same that passes between emergence of the adult and the beginning of its first nuptial feast; however, much longer times can elapse before it is begun.

Once inseminated, females can proceed with successive experimental and definitive nesting in the absence of a male.

When several females engaged in the nuptial feast occur in the same terrarium, a strong competition for space ensues. Each female tries to isolate her balls from other females, which may attack and eat them. Occasionally, fights occur for possession of balls in which each grapples with the other while lying on her side.

DISCUSSION

Undoubtedly, behavior of *Eurysternus* adults isolates this taxon from the two main evolutionary lines of feeding-nesting behavior of the scarabaeines (see Halffter, 1977). Although the species comprising the genus are morphologically uniform, the few species studied suggest two very different patterns of nesting behavior. Adults of the species described here, as well as those of *E. mexicanus*, display a complex nesting behavior designated Group VI by Halffter (1977). Another much simpler behavior is displayed by *E. foedus,* Guérin-Ménéville and a Mexican species (see discussion below). The characteristics of Group VI, as illustrated by those species considered above are the following:

1) Balls are made only by females during the nuptial feast, the first phase of an elaborate nesting procedure. Moreover, most are made in large numbers and not rolled.

The nesting behavior of eurysternines, unlike that of scarabaeines, cannot be considered a derivative of feeding behavior. There are long periods during which feeding occurs but no ball-making, and there is direct feeding from a dung mass even though balls have been constructed. Balls can, however, be eaten. The fact that a large number of balls are made and left on the surface near the dung source (as opposed to being rolled away and buried as is done by Scarabeini) means that *Eurysternus* does not profit from the competitive advantages of rolling behavior; namely, less aggregation and more efficient use of resources. Ball-making by *Eurysternus* is, rather, a process related only to reproduction and which is correlated with a certain stage of ovarial development.

2) Nests are multiple. A multiple nest is a group of brood balls, each with an egg, where development takes place. Multiple nests cared for by parents (particularly the female) have arisen three different times, presumably independently, in Scarabaeinae. Although there are similarities in form and care, of the nest in each group, the way in which each is prepared is completely different.

In Group III (see Halffter, 1977) a male and female construct an underground chamber into which dung is brought and from which a female constructs brood balls. In Group V, a multiple nest arises from an addition of single balls rolled from a dung source and modelled independently. In *Eurysternus*, the balls comprising the nest are "selected" from a larger number prepared during the nuptial feast. Moreover, there are other differences. Females of Group III prepare a single nest where larval-pupal development is very long; fecundity is very low. In Groups V and VI, each female prepares several nests (*Eurysternus* females prepare several definitive nests) with intermediate periods of feeding. Even though a male may participate in nesting in all three groups, it is much more significant in Group III and non-existent in the definitive nests of *Eurysternus* (Group VI).

Nevertheless, the most distinctive feature of multiple nests of *Eurysternus*, and exclusive to

them, are the experimental nests, which occur to various degrees in the three species studied here. Nothing even similar to experimental nests are known in other scarabaeines.

3) Nesting behavior follows the sequence a) nuptial feast, b) experimental nesting, c) definitive nesting. Females of *E. magnus* do not build experimental nests. But in *E. caribaeus*, *E. magnus* and *E. mexicanus* (Halffter, 1977) experimental and definitive nests are craters containing several brood balls. In *E. balachowskyi* the experimental nest is a crater, but the definitive nest is not (see above). When the brood balls are covered and united with soil by female *E. caribaeus*, the definitive nest is established. Care of a definitive nest is similar, but more elaborate by females of *E. balachowskyi*. Even though covered by a layer of soil, the brood balls of *E. magnus* and *E. mexicanus* are not united by soil and the balls are continually turned during care. Temporary care of experimental nest balls by *E. balachowskyi* females also includes periodic turning.

Our studies of *E. caribaeus* show that the state of ovarial development is linked with reproductive behavior. Maturation of a series of oöcytes coincides with nuptial feast; copulation determines termination of vitellogenesis, beginning of oviposition, and nest preparation. Nevertheless, unlike other scarabaeines, there is poor synchronization between ovarial development and nesting behavior. Our belief is that experimental nesting is attributable to a continuation of oocyte formation and maturation after a nest has been established. Thus, a female is influenced by contradictory signals: nesting behavior tends to promote continuance of nest care, while ovarial function promotes the construction of a new nest. Once the two signals come into phase, they reinforce each other (which may take an extended period of time), and definitive nesting ensues. If our hypothesis is true, formation of oöcytes must be slowest and more staggered in *E. magnus* and most rapid and unrelenting in *E. balachowskyi* and *E. mexicanus*.

If we suppose that reproductive behavior of scarabaeines in general tends toward being a K–strategy, the strategy is somewhat maladjusted in *Eurysternus* as compared to other known groups in that much reproductive effort is lost as a result of experimental nesting.

Since a male joins a female during preparation of nuptial balls, the latter behavior can be interpreted as a signal to a male that a female is physiologically prepared for copulation and oögenesis. Perhaps also a large number of nuptial balls is a better inducement for the male's parental investment than a small number, as a sort of proof of the female's nidificatory prowess. Thus, the nuptial feast may be the result of Darwinian sexual selection (in this case exercised by the male) in favor of advancing the usual nidificatory ball-making process to a period long preceding actual nidification. Transition between the early nuptial stage, favored by sexual selection, and the definitive nesting stage, favored by natural selection, can apparently be somewhat indefinite and confused in some species, since it is not in itself subject to any direct selection pressure. The resultant wastefulness of this intermediate experimental stage is presumably not sufficient to offset the combined selective advantages of the first and last stages.

Nesting behavior described so far is not universal to *E. foedus* and a yet unidentified Mexican species nest in a completely different manner. Females of these species bury shallowly a compact mass of excrement into which several eggs are laid. Larvae develop freely without encountering each other or moving around much. The dung mass later contains two or three tubular spaces created by the developing progeny. Among other differences, there is no ball-making or nest crater. This nesting pattern is remarkably like that of *Onitis caffer* Boheman and *O. aygulus (F.)*, which Halffter and Matthews (1966) assigned to Group I. Such

behavior, which Halffter and Matthews (1966) considered an evolutionary antecedent to multiple nests, is no more characteristic of *Onitis* (and Onitini in general) than it appears to be for *Eurysternus*. How common it may be to *Eurysternus* remains to be seen.

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THE LARVAE OF FOUR *HYDROPSYCHE* SPECIES WITH THE CHECKERBOARD HEAD PATTERN (TRICHOPTERA: HYDROPSYCHIDAE)

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ABSTRACT

Diagnostic characters to distinguish among larvae of four species of Hydropsyche *from Saskatchewan (*H. bifida *Banks,* H. recurvata *Banks,* H. walkeri *Betten and Mosely, and* H. bronta *Ross) with checkerboard pattern of light and dark areas on the dorsum of the head include: differences in color of head and pronotum, body proportions, and secondary setation. A key is provided to larvae of these four species.*

*Les larves de quatre espèces d'*Hydropsyche *de la Saskatchewan, caractérisées par un motif en damier de taches pâles et foncées sur la surface dorsale de la tête, se distinguent les unes des autres par des différences dans la coloration de la tête et du pronotum, dans les proportions du corps, et dans la chétotaxie secondaire. On présente une clé d'identification des larves de ces quatre espèces.*

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INTRODUCTION

Larvae of six hydropsychid species, *Hydropsyche bifida* Banks, *Hydropsyche recurvata* Banks, *Hydropsyche walkeri* Betten and Mosely, *Hydropsyche bronta* Ross, *Hydropsyche*

cheilonis Ross, and *Hydropsyche morosa* Hagen, have a characteristic checkerboard pattern of light and dark areas on the dorsum of the head (Figs. 3, 5a). Some individuals have a slightly modified version of the pattern characteristic of their species (Figs. 5b, 6). Larvae of these six species are difficult to distinguish and previous taxonomic studies (Ross, 1944; Schuster and Etnier, 1978) failed to effectively separate them.

Schuster and Etnier, (1978) wrote that three small light spots at the posterior end of the frontoclypeal apotome distinguish larvae of *H. morosa* from larvae of the other five species with the checkerboard head pattern, which either have no light spots, or a single large light spot at the posterior end of the frontoclypeal apotome. It is doubtful that three spots on the frontoclypeal apotome is diagnostic, since Mackay (1978) illustrated an *H. morosa* larva with a single large light spot.

Mackay (1978) distinguished larvae of *H. bronta* and *H. morosa* by differences in head widths of each instar of the two species, those of *H. morosa* having a consistently larger mean head width at each instar. This method is of limited use in normal taxonomic work as it requires measurement of many specimens from each locality studied. Also, this method may fail to discriminate between larvae from the same locality if more than two species with the checkerboard head pattern are represented in the collections.

In Saskatchewan four species of *Hydropsyche* larvae with checkerboard head pattern were collected: *H. bifida, H. recurvata, H. bronta,* and *H. walkeri.* In this paper we report results of our study of those taxa.

METHODS

Larval sclerites from pupal cases of reared specimens of *H. bifida*, *H. recurvata*, *H. bronta*, and *H. walkeri* were mounted on slides. We found consistent differences, and used them to identify larvae. Identified larve were then studied for additional diagnostic features. Detailed study of body setation was facilitated by clearing specimens and mounting various body parts on slides for study with a compound microscope.

Several measurements were made of heads of larvae of each species. Widths of heads and measurements of the frontoclypeal apotome (Figure 7) were determined as follows:

1 aa width of apotome at level of anterolateral lobe
2 bb width of apotome just posterad of anterolateral lobe
3 cc width of apotome at level of tentorial pits
4 dd width of apotome at widest portion of posterior part
5 ee width of apotome at level of the pits in posterior part
6 g distance from anterior margin of apotome to lateral pit
7 h distance from lateral pit to anterior margin of tentorial pit
8 k distance from anterior margin of apotome to medial pit *H. bifida* the anterior margin gradually bends posterolaterad to meet the anterolateral corner (Figs. 1, 2 & 11). In *H. walkeri* the anterior margin projects anterolaterad as a small rectangular lobe (Figs. 3, 4, & 12).

Six ratios calculated from these measurements were used to describe shapes and proportions statistically,as follows:

1. Head width/length of frontoclypeal apotome (HW/FL).

2. Width of frontoclypeal apotome at level of tentorial pits/length of frontoclypeal apotome (FW/FL).
3. Width of frontoclypeal apotome just posterad of anterolateral lobes/width of frontoclypeal apotome at level of anterolateral lobes (BL/L).
4. Distance from anterior margin of frontoclypeal apotome to mesal pit on anterior part of frontoclypeal apotome/distance from anterior margin of frontoclypeal apotome to lateral pit on anterior part of frontoclypeal apotome;
5. Distance from lateral pit on anterior surface of frontoclypeal apotome to anterior edge of tentorial pit/length of frontoclypeal apotome.
6. Width of frontoclypeal apotome at level of pits on posterior part of frontoclypeal apotome/width of frontoclypeal apotome at level of widest part of posterior part of apotome.

Only the first three ratios are discussed further, because they are useful for discrimination of species. Measurements for ratios BL/L and FW/FL were taken from mature (fourth and fifth instar) larvae, and from sclerites extracted from cases of reared pupae. Measurements for the ratio HW/FL were taken only from mature larvae. All specimens measured are from Saskatchewan. Range, mean, 1.5 standard deviations (SD) and 95% confidence limits (CL) were determined for each ratio for each species (Tables 1-3); these data are illustrated in Figs. 15–17.

RESULTS

We treat features diagnostic for larvae of the four species examined in this study. For more complete descriptions consult Schuster and Etnier, Etnier (1978).

Color Pattern

Coloration must be used cautiously as a diagnostic feature for larvae of species with checkerboard head pattern because of variability and overlap.

H. bifida Banks. – Head coloration of *H. bifida* larvae is quite distinctive compared to head coloration of larvae of the other three species. In *H. bifida,* ground color of venter and dorsum of the head is dark brown in almost all specimens, these dark regions contiguous posterolaterally (Fig. 11) in most specimens. Most specimens of the other three species have a lateral light area between the dark dorsal and ventral regions of the head (Figs. 12, 13), if indeed these regions are dark. *H. bifida* larvae have distinct light spots on sides of the head (Fig. 11), these spots contrasting with the dark lateral surface. Larvae of the three other species lack spots on side of head, which contrast as noticeably with ground color of head (Figs. 12, 13) as in *H. bifida.* There are also one to three white spots on the dorsal surface of each parietal sclerite just anterad of seta 17 (Fig. 1). The light region around the eye of most specimens does not extend posterodorsad towards the margin of the parietal sclerite (Fig. 1), as in *H. recurvata* (Fig. 5a), *H. bronta* (Fig. 6), and most *H. walkeri* larvae (Fig. 3).

Schuster and EtnierEtnier (1978) noted that many *H. bifida* larvae are without anterior and posterior spots on the dorsum of the head. Many Saskatchewan *H. bifida* larvae lack these

spots and when the large single spot is absent from the posterior end of the frontoclypeal apotome, several smaller light spots are evident (Fig. 1).

TABLE I

Variation in the ratio HW/FL for *H. bifida, H. recurvata, H. bronta,* and *H. walkeri*

	N	Mean	Range	1.5 SD	CL
H. recurvata	29	1.139	0.986–1.260	0.071	1.121–1.157
H. bifida	33	1.108	1.055–1.175	0.051	1.096–1.121
H. walkeri	42	1.149	1.060–1.300	0.071	1.133–1.164
H. bronta	21	0.959	0.882–1.000	0.047	0.945–0.974

The pronotum has numerous small white spots on each lateral surface (Fig. 14).

H. walkeri Betten and Mosely. – Schuster and EtnierEtnier (1978) reported *H. walkeri* larvae with heads almost entirely light in color (as in Fig. 5b), but larvae examined by us have dark heads with checkerboard pattern on the frontoclypeal apotome (Fig. 3). Some individuals have, some lack, (Fig. 12) light spots on sides of head; these spots do not contrast as markedly with ground color of the head as in *H. bifida. H. walkeri* larvae have a light area at the posterior end of the frontoclypeal apotome, and there is a distinctive light spot laterad of seta 16 (Fig. 3). Light spots are lacking from the region of the head just anterad of seta 17, and most specimens have a light area directed posterodorsad from the region around the eye. Most specimens have a broad, dark stripe along the coronal suture (Fig. 3); this stripe is absent from or less well developed in larvae of the other three species. Most specimens with the dorsal and ventral regions of the head dark, have these regions separated by a light lateral area.

Lateral spots on the pronotum are only slightly lighter than ground color.

H. recurvata Banks. – Head coloration of *H. recurvata* larvae is extremely varied, from almost entirely dark to almost entirely light (Fig. 5b) (Ross, 1944; Schuster and Etnier, Etnier1978). Most *H. recurvata* larvae lack light spots anterad of seta 17 as this area is occupied by a light area which extends dorsad and posterad from the light region around the eye (Fig. 5a). In dark specimens of *H. recurvata* light spots are not evident on the lateral and dorso-lateral regions of the posterior part of the head (Fig. 13). In lighter larvae some yellow spots are evident but they do not contrast markedly with ground color of the head. If dorsal and ventral regions of the head are both dark, they are separated laterally by a light area (Fig. 13) in most specimens.

Pronotal spots, if evident laterally, are darker than the ground color.

TABLE II

Variation in the ratio FW/FL for *H. bifida, H. recurvata, H. bronta,* and *H. walkeri*

	N	Mean	Range	1.5 SD	CL
H. recurvata	39	0.662	0.608–0.713	0.038	0.654–0.671
H. bifida	38	0.651	0.608–0.700	0.032	0.644–0.657
H. walkeri	42	0.647	0.602–0.695	0.035	0.640–0.655
H. bronta	29	0.558	0.522–0.595	0.027	0.551-0.565

H. bronta Ross. – Schuster and Etnier Etnier(1978) described two forms of *H. bronta*, based on differences in larval head patterns, from different regions of their study area. The Central Form has the typical checkerboard head pattern, but the Appalachian Form has a transverse striped head pattern (Fig. 6). Adults associated with the two larval forms are indistinguishable. In Saskatchewan both larval forms were collected, often from the same river. It is likely these two color forms are conspecific variants.

Small light spots are evident laterally on heads of some *H. bronta* larvae, but most larvae lack them. The light area around the eyes of most larvae is extended posterodorsad to the region anterad of seta 17 (Fig. 6). Ventral and lateral surfaces of the head are predominantly light. On each parietal sclerite of many larvae is a brown spot near the ventral ecdysial line and another on the ventrolateral surface in the vicinity of the stridulatory surface.

Pronotal sclerites lack contrasting dark or light spots laterally.

Head Setation

Head setation is most readily observed on cleared specimens mounted on slides. Head capsules of hydropsychid larvae possess a rich secondary setation, these setae being greatly modified in many species. The *Hydropsyche* larvae examined in this study have three main types of secondary setae on the head. The first is stout, dark, peg-like setae prominent on much of the dorsal and posterolateral regions of the parietal sclerites, and also on the frontoclypeal apotome of larvae of some species. The second type is fine setae present for most specimens on anterodorsal and posterodorsal regions of the parietal sclerites and on the frontoclypeal apotome. Larvae of some *Hydropsyche* species have setae intermediate between these first two types. The third type of secondary setae is along the anterior margin of the frontoclypeal apotome. These setae are extremely small with their blunt apical ends minutely divided.

Information about setation for abraded heads can be gained by determining size and number of sockets left where setae were attached. Sockets at bases of peg-like setae are larger

TABLE III

Variation in the ratio BL/L for *H. bifida, H. recurvata, H. bronta,* and *H. walkeri*

	N	Mean	Range	1.5 SD	CL
H. recurvata	46	0.93	0.889–0.959	0.026	0.925–0.935
H. bifida	39	0.892	0.84–0.944	0.036	0.884–0.900
H. walkeri	42	0.903	0.857–0.943	0.029	0.897–0.909
H. bronta	28	0.857	0.814–0.89	0.03	0.849–0.864

than those of the fine setae. Number of sockets in the rubbed area indicate number of setae previously present in that region.

H. bifida Banks. – Larvae of *H. bifida* have many long, fine setae on the posterior part of the frontoclypeal apotome, and on the region of each parietal sclerite laterad of the posterior end of the frontoclypeal apotome (Figs. 8, 11). Peg-like setae are absent from the posterior part of the frontoclypeal apotome (Figs. 1, 8).

H. walkeri Betten and Mosely. – Numerous long, fine setae are on the posterior part of the frontoclypeal apotome, and on the region of each parietal sclerite laterad of the posterior end of the frontoclypeal apotome (Figs. 8, 12). Peg-like setae are absent from the posterior part of the frontoclypeal apotome (Fig. 3).

H. recurvata Banks. –

The central portion of the posterior part of the frontoclypeal apotome has few, fine, very short setae (Figs. 9, 13). Fine setae are more abundant on the parietal sclerites laterad of the posterior end of the frontoclypeal apotome. A few peg-like setae are present on the posterior part of the frontoclypeal apotome (Figs. 5a, 5b, 9).

H. bronta Ross. – Like *H. bifida* larvae, those of *H. bronta* have numerous fine setae on the posterior part of the frontoclypeal apotome (Fig. 10), although these setae are shorter in *H. bronta*. There are also peg-like setae, and setae which are intermediate in thickness between the fine and peg-like setae, on this region of the frontoclypeal apotome, and on the parietal sclerites in the region laterad of the posterior end of the frontoclypeal apotome. Most peg-like setae on heads of *H. bronta* larvae are more acuminate than in the other three species.

Shape of Head and Head Sclerites

Based on shape of head and frontoclypeal apotome, the four species considered in this study are arranged in two groups. In Group I head width of almost all specimens is greater than frontoclypeal apotome length, and the frontoclypeal apotome is much wider in relation to its length than in Group II. In Group II width of head is equal to or less than length of the frontoclypeal apotome, and the latter is much narrower in relation to its length than in Group I. Larve of these four species differ in values for ratos HW/FL (Fig. 15) and FW/FL (Fig. 16).

The ratio HW/FL (Fig. 15) shows that heads of *H. bronta* larvae are much narrower in relation to length of frontoclypeal apotome than are heads of the other three species. The ratio FW/FL (Fig. 16) indicates that *H. bronta* larvae have much longer, narrower frontoclypeal apotomes than do larvae of the other three species. Based on these ratios it is clear that three of the four species studied, *H. bifida*, *H. walkeri*, and *H. recurvata*, belong to Group I while only *H. bronta* belongs to Group II. We calculated values for ratios HW/FL and FW/FL from a drawing of the larva of *H. morosa* in Mackay (1978). Values obtained indicate that *H. morosa* probably belongs in Group II, if the drawing accurately represents the species.

Among the four species studied there are differences in relative size of anterolateral lobe of frontoclypeal apotome. In *H. bronta* these lobes are prominent while in *H. recurvata* they are only slightly developed. In *H. bifida* and *H. walkeri* development of these lobes is intermediate between those of *H. bronta* and *H. recurvata.* The ratio BL/L (Fig. 17) illustrates the difference in development of the anterolateral lobes of the frontoclypeal apotome among the four species.

Hydropsyche bifida and *H. walkeri* larvae differ in shape of the anterior part of the frontoclypeal apotome. In *H. walkeri* larvae each lateral margin of the anterior part bulges outward (Figs. 3, 4), while in most, but not all *H. bifida* larvae the margin is straight (Figs. 1, 2). Larvae of these species also differ in the shape of anterior margin of the frontoclypeal apotome. In *H. bifida* the anterior margin gradually bends posterolaterad to meet the anterolateral corner (Figs. 1, 2 & 11). In *H. walkeri* the anterior margin projects anterolaterad as a small rectangular lobe (Figs. 3, 4, & 12).

Key to Species

1a		Ratio FW/FL 0.522 –0.595	*H. bronta*
1b		Ratio FW/FL 0.602 –0.713	2
2a	(1b)	Dorsum of head with numerous long, fine setae on middle of posterior part of frontoclypeal apotome (Figs. 8, 11, 12); no peg-like setae on posterior part of frontoclypeal apotome (Figs. 1, 3, & 8); side of head with (Fig. 11) or without (Fig. 12) light spots	3
2b		Middle of posterior part of frontoclypeal apotome with few short, fine setae (Figs. 9, 13); peg-like setae on posterior part of frontoclypeal apotome (Fig. 5b); side of head without contrasting light spots (Fig. 13)	*H. recurvata*
3a	(2a)	Anterolateral margin of frontoclypeal apotome gradually curved posterad to anterolateral corner of apotome (Figs. 1, 2, 11)	*H. bifida*
3b		Anterior margin of frontoclypeal apotome projected forward as small rectangular lobe near each anterolateral corner of apotome (Figs. 3, 4, & 12) . . .	*H. walkeri*

DISCUSSION

Diagnostic features described above must still be tested on populations of these species in other parts of North America for study of larvae with checkerboard head pattern is still incomplete. Search for new and perhaps better features for identification for these species must continue, preferably with inclusion of all species with this head pattern. We believe our results will be useful to anyone undertaking this task.

ACKNOWLEDGEMENTS

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We thank David Wong for his skillful preparation of the graphs.

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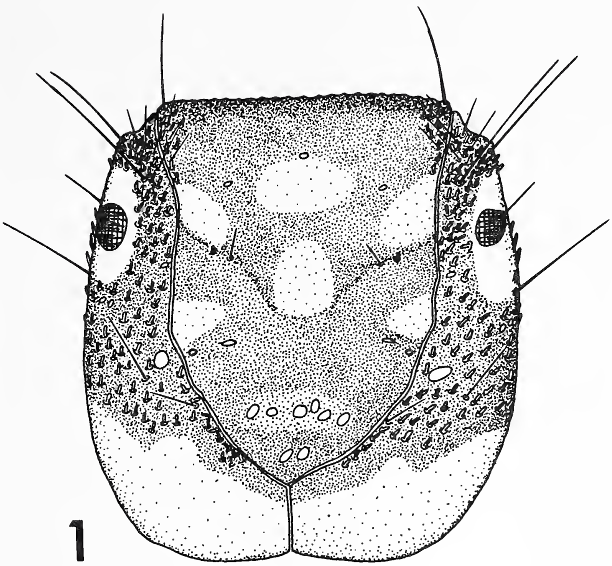

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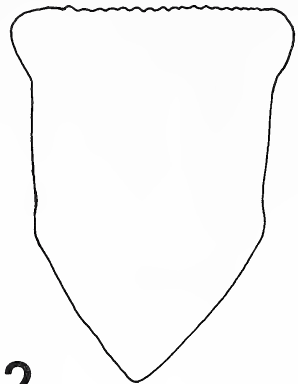

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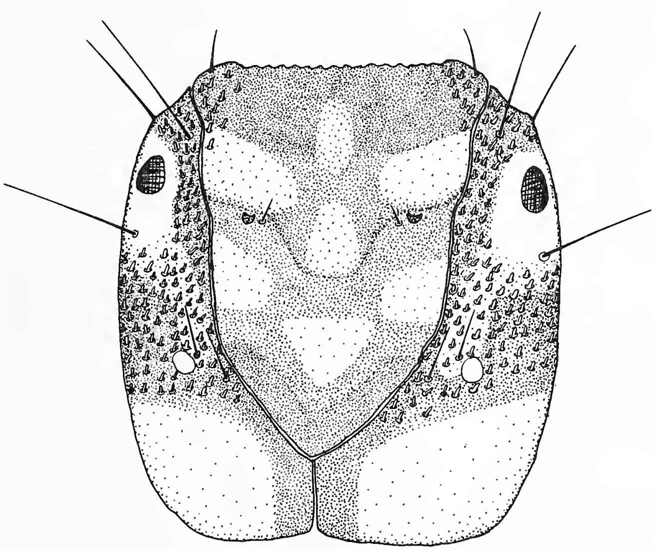

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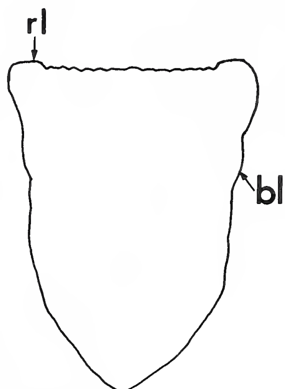

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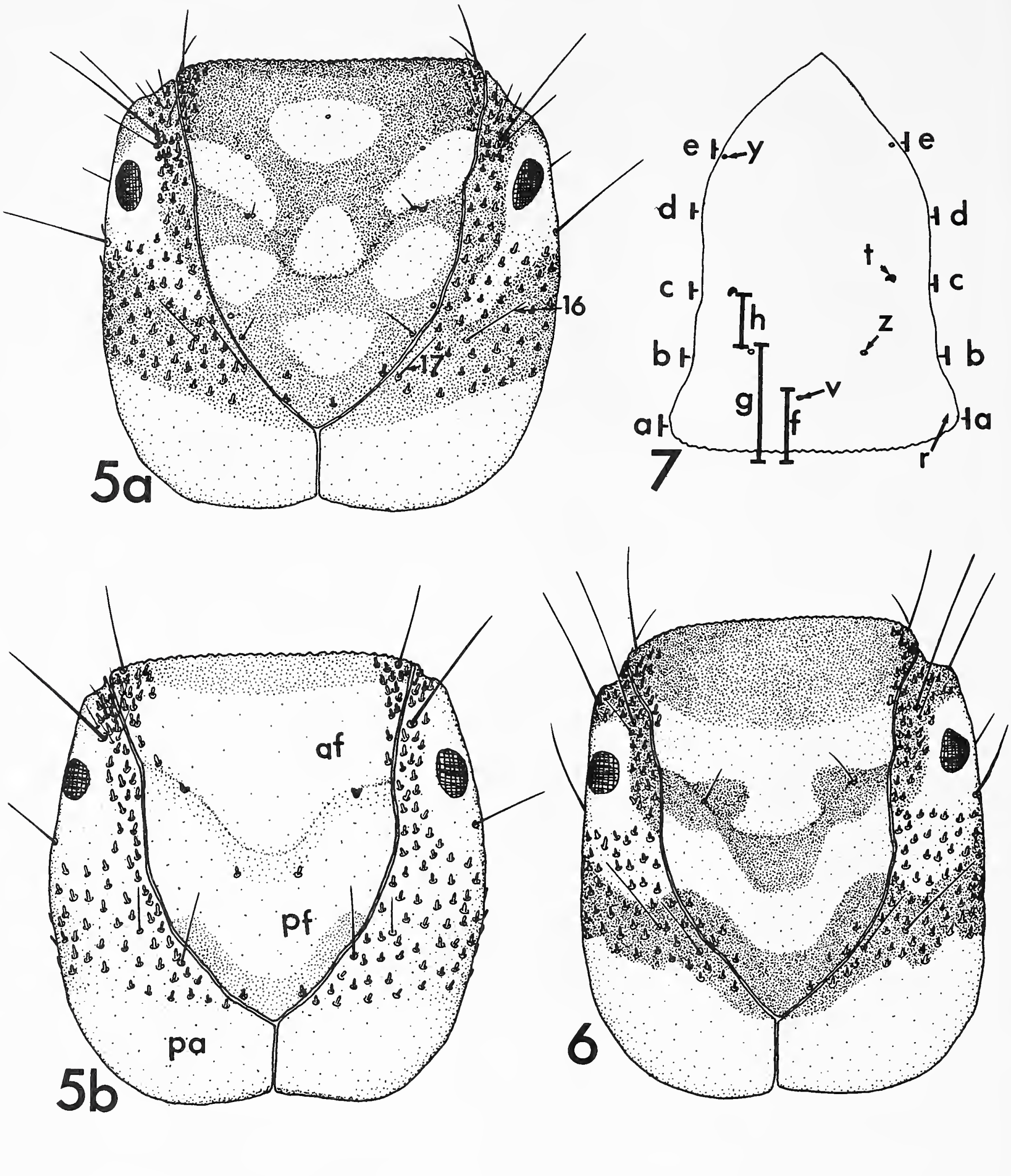
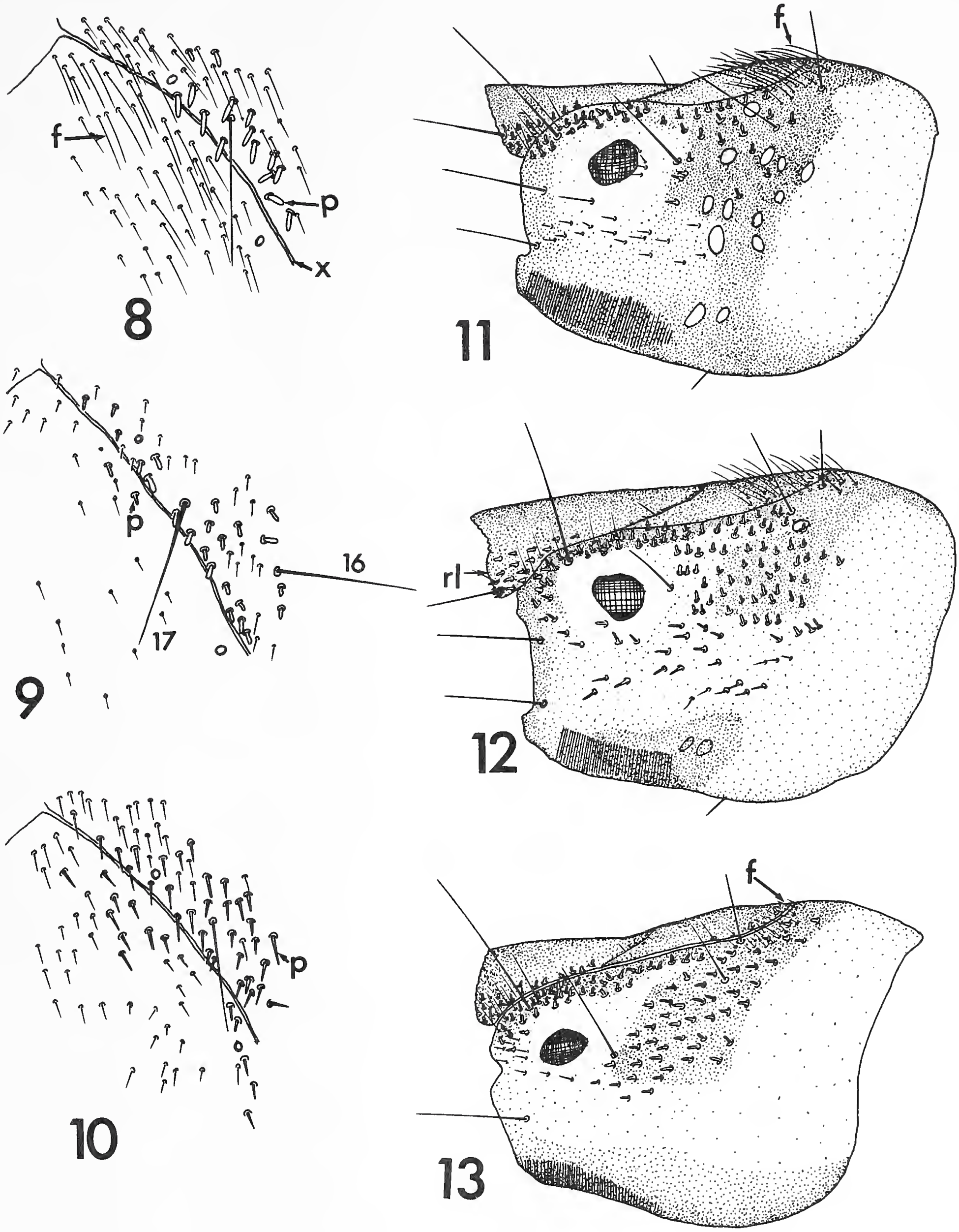
Figs. 1–4. Fig. 1. *H. bifida* head, dorsal aspect; Fig. 2. *H. bifida* frontoclypeal apotome; Fig. 3. *H. walkeri* head, dorsal aspect; Fig. 4. *H. walkeri* frontoclypeal apotome showing bulge on side of front part of apotome (bl) and rectangular lobe on lateral portion of anterior margin (rl).



Figs. 5–7. Fig. 5a. *H. recurvata* head, dorsal aspect; Fig. 5b. *H. recurvata* head, dorsal aspect, showing anterior part of frontoclypeal apotome (af), posterior part of frontoclypeal apotome (pf) and parietal sclerite (pa); Fig. 6. *H. bronta* head, dorsal aspect; Fig. 7. *Hydropsyche* frontoclypeal apotome (schematic) showing locations where measurements were taken; also anterolateral lobe (r), tentorial pit (t), medial pit on anterior part (v), lateral pit on anterior part (z) and pit on posterior part (y).



Figs. 8–13. Fig. 8. *H. bifida* dorsum of head showing fine setae (f), peg-like setae (p), and frontoclypeal suture (x); Fig. 9. *H. recurvata* dorsum of head showing peg-like seta (p); Fig. 10. *H. bronta* dorsum of head showing peg-like seta (p); Fig. 11. *H. bifida* head, lateral aspect, showing fine setae (f); Fig. 12. *H. walkeri* head, lateral aspect showing rectangular lobe (rl); Fig. 13. *H. recurvata* head, lateral aspect, showing fine setae (f);

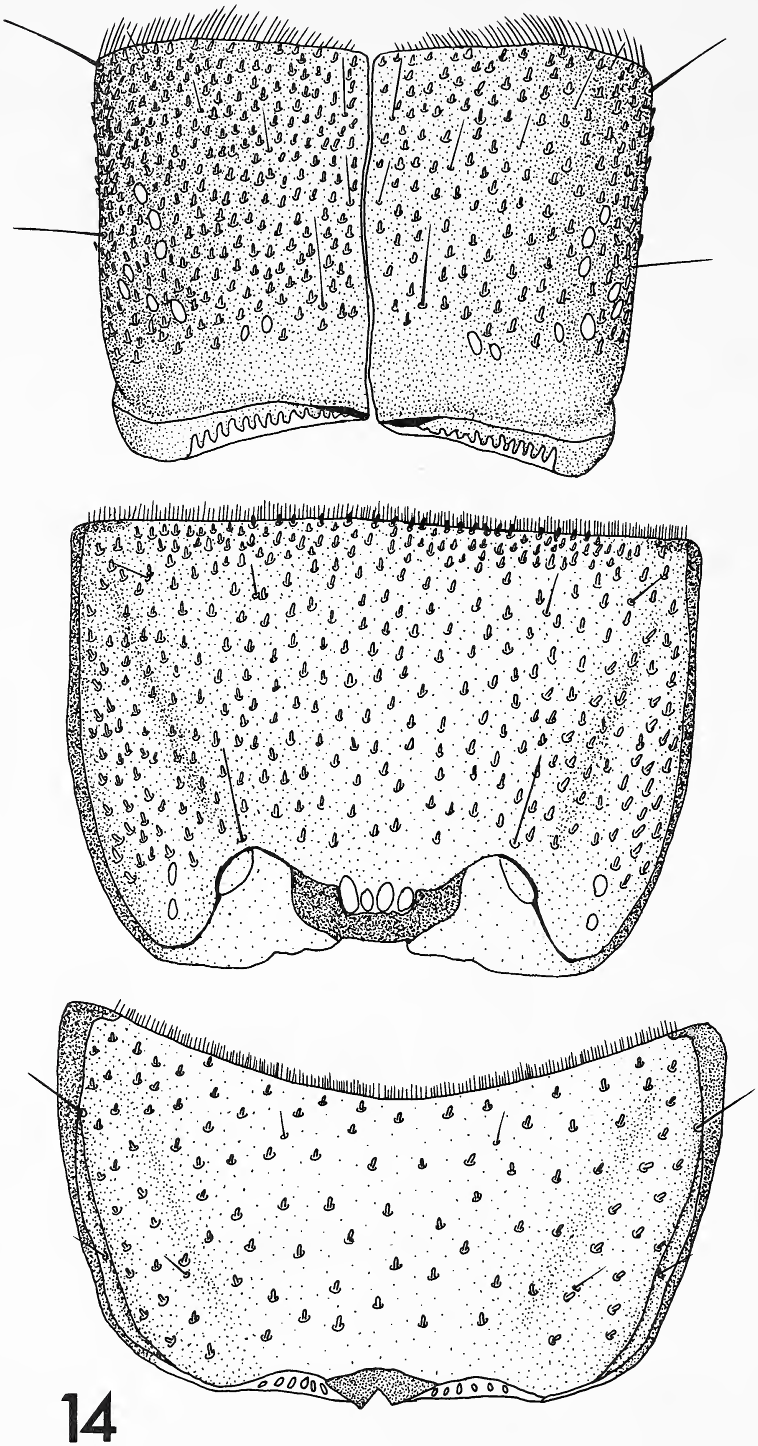


Fig. 14.–Thoracic sclerites of *Hydropsyche bifida*.

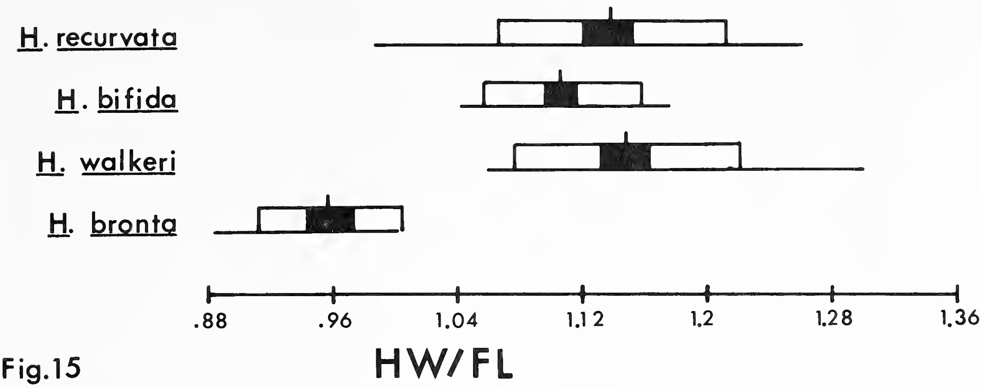


Fig.15

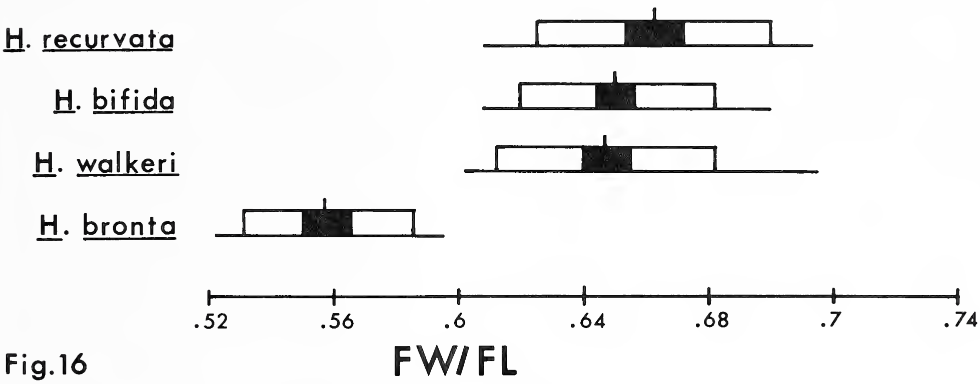


Fig.16

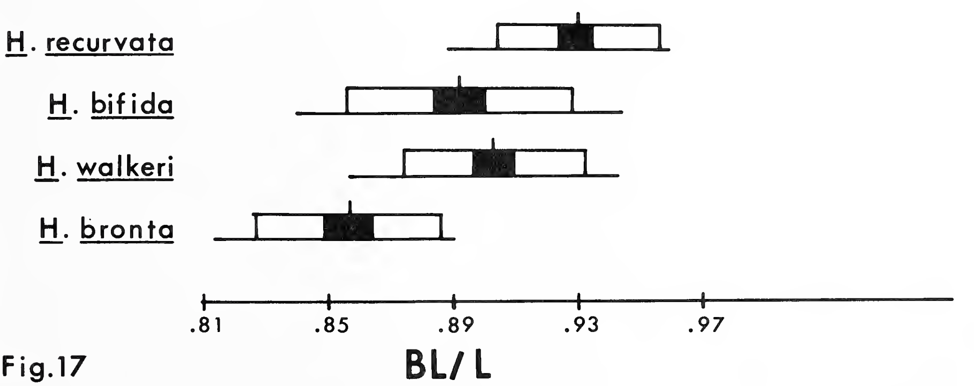


Fig.17

Figs. 15–17. Fig. 15. Variation in the ratio HW/FL for *H. bifida*, *H. recurvata*, *H. bronta*, and *H. walkeri*. Data for each species is represented as follows: range, by basal horizontal line, mean by medial vertical line, confidence limits by dark box and 1.5 standard deviations on each side of the mean by the clear box. Fig. 16. Variation in the ratio FW/FL for *H. bifida*, *H. recurvata*, *H. bronta* and *H. walkeri*; for explanation, see caption of Fig. 15; Fig. 17. Variation in the ratio BL/L for *H. bifida*, *H. recurvata*, *H. bronta* and *H. walkeri*. For explanation see caption of Fig. 15.

ANALYSIS OF TWO PROBLEMATIC NORTH AMERICAN CADDISFLY SPECIES: *OECETIS AVARA* (BANKS) AND *OECETIS DISJUNCTA* (BANKS) (TRICHOPTERA: LEPTOCERIDAE)

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ABSTRACT

Oecetis disjuncta *(Banks) has, since 1944, been regarded as possibly conspecific with* Oecetis avara *(Banks). We propose here that these two forms are specifically distinct. Adults, larvae, and pupae of both species are described. In Saskatchewan* O. avara *lives in southern and central regions, while* O. disjuncta *inhabits central and northern regions. Immatures of both species inhabit boreal streams, but those of* O. avara *also inhabit the main branches of the Saskatchewan river system. Because specimens of* O. disjuncta *may, previously, have been misidentified as* O. avara, *some published distribution records for the latter may not be correct. Collection data for specimens examined in this study indicate that both species are widely distributed in North America.*

Depuis 1944, on considérait Oecetis disjuncta *(Banks) comme un synonyme possible d'*Oecetis avara *(Banks). Nous proposons qu'*O. disjuncta, *bien que morphologiquement similaire à* O. avara, *soit considéré comme une espèce distincte. Nous décrivons les adultes, les larves, et les pupes des deux espèces. En Saskatchewan,* O. avara *occupe les régions du centre et du sud, alors qu'*O. disjuncta *se trouve dans les régions di cemtre et du nord. Les immatures des deux espèces habitent les affluents secondaires boréaux, mais ceux d'*O. avara *se trouvent aussi dans les branches principales du bassin de la rivière Saskatchewan. Etant donné qu'suparavent, des spécimens d'*O. disjuncta *pourraient avoir été identifiés comme* O. avara, *certaines mentions publiées au sujet de la répartition géographique de cette dernière pourralient être erronées. Les notes de collection des spécimens examinés au cours de cette étude indiquent que les deux espèces sont largement répandues en Amérique du Nord.*

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INTRODUCTION

While studying Saskatchewan–collected males of *Oecetis avara* (Banks), we discovered that two distinct color forms are recognizable: one with dark brown body and wings (dark form); and another with yellow body and wings (light form). In central Saskatchewan, where both forms occur, the main emergence of dark form adults is earlier in the year than that of light form adults. Comparison of male genitalia of the two forms revealed differences in structure of claspers and aedeagus. In the dark form, claspers lack a prominent ventrocaudal lobe (Fig. 1), and the aedeagus, in caudal aspect, is symmetrical (Figs. 5, 7). In the light form, claspers possess a prominent ventrocaudal lobe (Fig. 3), and the aedeagus is asymmetrical, in caudal aspect (Figs, 6, 8). Differences in form of male genitalia between two forms of putative *O. avara* associated with differences in general body coloration, and timing of adult emergence, suggested to us that we were studying not just variants of a single species, but two distinct species. We then searched for differences in other life stages.

We were able to associate adult females, larvae, and pupae with males of the dark and light forms, respectively, and morphological differences were found which discriminate between them.

We also examined '*O. avara*' specimens loaned to us by Dr. G. B. Wiggins of the Royal Ontario Museum (ROM). These had been collected from 11 North American localities outside Saskatchewan. The dark form was recorded from eight localities, the light form from three; there was no overlap. Adults of dark and light forms from the 11 localities are morphologically consistent with adults of their equivalents from Saskatchewan. Presence of dark and light forms in collections of '*O. avara*' from localities outside of Saskatchewan indicates that these forms are not local variants, restricted to Saskatchewan, but both are widely distributed in North America. This further strengthened our conclusion that the two forms are distinct species.

The type specimens of *O. avara* and *O. disjuncta*

The two species recognized by us could not be named, based on published information. *O. avara* belongs to the *disjuncta* species group of the genus *Oecetis*. The *disjuncta* group contains three species, *O. elatus* Denning and Sykora, *O. avara* (Banks), and *O. disjuncta* (Banks). Taxonomic status of *O. disjuncta* has remained in doubt since Ross (1944) suggested that this form might be conspecific with *O. avara*. Drawings of the male genitalia of *O. avara* (Ross, 1944), and of *O. disjuncta* (Banks, 1920) indicate that males of both species have a prominent ventrocaudal lobe on the clasper, but that the dorsal region of the clasper in *O. disjuncta* is much larger than it is in *O. avara*. Ross (1938), however, stated that the male genitalia of the type specimens of *O. avara* and *O. disjuncta* were very similar, which suggested to us that

Banks' (1920) drawing of the clasper of *O. disjuncta* might be inaccurate.

We examined the genitalia of male type specimens of *O. avara* and *O. disjuncta*, and found that each clasper of the holotype of *O. avara* has a prominent ventrocaudal lobe. The clasper of the lectotype male of *O. disjuncta*, however, lacks a prominent ventrocaudal lobe, although Banks' (1920) drawing of the genitalia of *O. disjuncta* illustrated this lobe. Also, the dorsal portion of the clasper of the type speciman of *O. disjuncta* is not markedly enlarged, although Banks drawing indicated it to be so. The aedeagus of the *O. avara* holotype is damaged and its structure could not be determined. The aedeagus of the type specimen of *O. disjuncta* is symmetrical, in caudal aspect.

Our study of the genitalia of the two forms revealed that male specimens were most effectively discriminated between by differences in aedeagal structure. Differences in clasper shape were useful for separating most specimens, but not for discriminating between a few specimens which had claspers intermediate in structure. Form of claspers and aedeagus of the *O. disjuncta* lectotype resemble those of males of the dark form. On this basis we concluded that the dark form was conspecific with *O. disjuncta*. Although the aedeagus of the *O. avara* holotype is damaged, and could not be compared to males of the light form, the claspers, with their prominent ventrocaudal lobes, leave no doubt that *O. avara* is conspecific with the light form of our study. We conclude that *O. disjuncta* and *O. avara*, are taxonomically distinct.

DESCRIPTIONS

This section is divided into two parts. In the first, selected morphological features of adults, larvae, and pupae of *O. disjuncta* and *O. avara* are discussed, to facilitate accurate identification of specimens and to provide comparative information about interspecific variation in certain structures. The second part provides detailed descriptions of adults, larvae, and pupae of *O. disjuncta* and *O. avara*.

Descriptions are based on examination of a large number of specimens in our collection taken throughout the province of Saskatchewan, as well as some from the ROM.

Comparison of selected features

Adults. – Although most adults of *O. avara* are yellow, and adults of *O. disjuncta* dark brown, some are intermediate. The tibial spur formula of *O. disjuncta* and *O. avara* is 1,2,2 which distinguishes these two species from the closely related *O. elatus* which, according to Denning and Sykora (1966), has a spur formula of 1,2,3.

The only feature of the male genitalia which is consistently different in the two species is structure of the aedeagus. In caudal aspect, the aedeagus of *O. disjuncta* is symmetrical (Figs. 5, 7), while in *O. avara* it is asymmetrical (Figs. 6, 8). There are no sclerotized areas on the apico–dorsal surface of the aedeagus in *O.disjuncta* (Figs. 5, 7), while in *O.avara* sclerotized areas are present on that region (Figs. 6, 8). Form of the claspers differs in the two species. Most males of *O. disjuncta* lack a prominent ventrocaudal lobe (Fig. 1), while males of *O. avara* have such a lobe (Fig. 3). However, in both species, some males have claspers that are nearly intermediate. Ventral margins of bases of claspers in the normal resting position are more widely separated in *O. avara* (Fig. 13)than they are in *O. disjuncta (Fig. 12)* The median process of tergum X consists of one (Fig. 10) or two (Fig. 9) lobes in *O. disjuncta*. Since both variants are represented in many series of males collected on the same date at the same locality,

and since no other morphological differences were detected between males with one or two lobes, we conclude that these variants are conspecific. In males of *O. avara* examined in this study the median process of tergum X is a single lobe (Fig. 11).

We identified some morphological differences between female genitalia, but it is uncertain if these will distinguish between all specimens. Sternum IX of females of both species has a similar pattern of coloration but, in *O. disjuncta*, the darkened area is much darker (Fig. 14) than in *O. avara* (Fig. 15). Body coloration is varied; possibly specimens will be found in which sternal color is intermediate, although we have not seen such intermediates. The lateral sclerite of segment IX also differs in shape in the two species. In *O. avara* (Fig. 17) the caudal margin of this sclerite is produced as a prominent ventrocaudal lobe, projected beyond the caudal margin of sternum IX in ventral aspect (Fig. 15). In *O. disjuncta* the ventrocaudal lobe of the lateral sclerite of segment IX is slightly developed or absent (Fig. 16) and, in ventral aspect (Fig. 14), this lobe does not project beyond the caudal margin of sternum IX. However, some females of *O. disjuncta* have a prominent ventrocaudal lobe on the lateral sclerite of segment IX. Although some females of *O. avara* and *O. disjuncta* may prove difficult to identify, most specimens can be readily separated using the features discussed above.

Larvae. – Larvae of *O. avara* and *O. disjuncta* are morphologically similar and, currently, only mature larvae of these two species can be assigned to species. The ventral apotome of the head capsule is much narrower, relative to its length, in *O. disjuncta* (Fig. 23) than in *O.avara* (Fig. 24). Difference in shape of the ventral apotome in larvae of these two species is reflected by difference in value of the width/length ratio for the ventral apotome of each species. Values for *O. disjuncta* are 1.7 – 2.8 ($\bar{x}$ = 2.23) and for *O. avara* 3.14 – 8.00 ($\bar{x}$ =4.48). Head color differs between most specimens of *O. avara* and *O. disjuncta but intermediate specimens were observed for both species. The dorsum of the head capsule in most specimens of O. disjuncta* is brown, marked by darker muscle scars (Figs. 18, 21), while in *O. avara* the head capsule is yellow, with muscle scars not contrasted with the ground color (Figs. 19, 22). In *O. disjuncta* larvae the dorsal setae of the distal articles of the thoracic legs (Figs. 33, 34) tend to be longer relative to the width of the parent article than are the equivalent setae in *O. avara* larvae (Figs. 35, 36).

Pupae. – Pupae of *O. avara* and *O. disjuncta* are morphologically very similar. The only distinguishing feature is relative length of four setae on front of head. In *O. disjuncta* (Fig. 38) the ventral pair of setae are shorter than the dorsal pair. In *O. avara* these four setae are subequal (Fig. 39).

Detailed descriptions

Oecetis disjuncta (Banks)

Oecetina disjuncta Banks, 1920: 351 (Type locality: California, Arroyo Seco Canyon, San Gabriel Mountains).

Adults. – Body and wings brown, legs yellow. Forewing with dark patches on stigma, at base of discoidal and of thyridial cells, on chord, at branching point of Cul, at juncture of anal and cubital veins, and at extremities of veins extended to wing margin. Tibial spur formula 1,2,2. Males 11–12 mm, females 10 – 12 mm in length.

Male abdominal segment IX annular; in lateral aspect (Fig. 1), dorsal half wider than ventral half, numerous setae on lateral surface; sternum, ventrally (Fig. 12), with large membranous area; cercus short, tubular (Fig. 1) or elongate with ventral surface concave. Clasper (Fig. 1), in lateral aspect, with dorsal margin rounded, posterior margin shallowly emarginate, ventrocaudal lobe reduced or absent; few specimens with posterior margin emarginate and ventrocaudal lobe present; ventromesal margins of both claspers, close together (Fig. 12). Segment X with pair of lightly sclerotized, triangular lateral lobes; mesal process of one (Fig. 10) or two (Fig. 9) lobes (in dorsal aspect), apex of lobes entire (Fig. 9) or incised (Fig. 10). Aedeagus, in lateral aspect (Fig. 2), with distal half directed ventrad; in caudal aspect (Figs. 5, 7), symmetrical, posterodorsal surface entirely membranous; internal sclerotized ring symmetrical in caudal aspect (Fig. 7).

Female genitalia with lateral sclerite of segment IX narrow (Fig. 16); ventrocaudal lobe absent or slightly developed, not extended beyond caudal margin of sternum IX (Fig. 14); few specimens with caudal lobe well developed, extended beyond caudal margin of sternum IX. Latter with ventral surface in form of raised, flattened, oval area (Fig. 14); pattern on oval area darker and more distinct than in *O. avara*, oval area bordered by dark area anteriorly and laterally. Cercus, in lateral aspect (Fig. 16), evenly rounded apically, short, not extended beyond segment X. Clasper, in lateral aspect (fig. 16), rectangular, with ventral and dorsal margins thickened. Segment X mostly membranous; ventrocaudal margin sclerotized, extended beyond rest of segment. Bursa copulatrix as in Figure 14.

Larva. – Head with dorsum dark yellow to brown, marked by darker spots (Figs. 18, 21); anterolateral region brown (Fig. 21), area about eyes white; lateral and posterolateral regions white except scattered brown spots (Fig. 21) and large brown area in middle of gena with few darker spots; venter of head (Fig. 23) light except brown ventral apotome, pair of brown triangular patches posterad of ventral apotome, and dark rim around occipital foramen. Cephalic seta 13 ventrad of midpoint between setae 14 and 15 (Fig. 18); seta 16 directly anterad of seta 17. Frontoclypeal apotome (Fig. 18) darkest laterally; posterior part with two large brown spots, one behind other, subdivided in some specimens; anterior part of frontoclypeal apotome with two pairs of brown spots; linear pale area between each anterolateral corner and rest of apotome (Figs. 18, 20). Each parietal sclerite (Fig. 18) with four brown spots along dorsomesal margin; more brown spots near margin with subocular line. Structure of labrum as in *O. avara*, spines of ventral comb as in Figure 29. Mandibles (Fig. 26) each with single blade, mesal margin basad of subapical teeth of most specimens without serrations. Plate on dorsal surface of submentum V–shaped (Fig. 25), with point of V directed caudad. Ventral apotome (Fig. 23) nearly as wide as long (width/length ratio values range 1.7–2.8; ($\bar{x}$ =2.23; n = 40); lateral margins of apotome rounded, anterolateral extensions present.

Pronotum (Fig. 32) with light anterior transverse band; middle with light brown transverse band; posterior region light, marked by few brown spots. Each mesonotal sclerite (Fig. 32) brown anteriorly, lighter posteriorly; one seta near anteromesal corner, 16 to 21 setae along anterior and lateral margins, three setae on middle of sclerite. Metanotum (Fig. 32) with sa2 of one to two setae; sa2 of one to three setae. Trochantin of propleuron (Fig. 30) with three to six setae on dorsal surface. Mesopleuron with single seta on each of episternum and epimeron. Metapleuron (Fig. 32) with as many as eight setae on episternum, one seta on epimeron. Foreleg (Fig. 33) without secondary setae on ventral surface of basal part of trochanter; anterior surface of apex of trochanter with two stout, spine–like setae on ventral surface, two

setae near distal oblique margin; setae on dorsal surface of femur longer relative to femur width than in *O. avara*; tibia with single spine–like seta on distal portion of anterior surface; claw as in *O. avara*. Structure of midleg and hindleg (Fig. 34) similar to *O. avara* except setae on dorsal surfaces of femur and tibia of these legs longer relative to width of article than in *O. avara*. Mesosternum without setae. Metasternum with two or three setae (in few individuals).

Abdomen with anterior gills on dorsum of segments II to VII and venter of segments II to VI; pair of pleural gills on segment II; gills absent from lateral lobes of segment I. Segment I with two groups of hooked spines at tip of median dorsal lobe (Fig. 32), each group wider than long. Segment IX with single seta near each lateral margin; posterior margin with six long and four short setae (Fig. 31). Hairs and spines sparse on membranous caudal surface of abdomen. Claw of anal proleg with two dorsal denticles.

Mature larvae 7 – 8 mm in length.

Pupa. – Labrum (Fig. 40) rounded, triangular; anterior margin extended anterad mesally as short, acute lobe. Mandibles (Fig. 37) with distal quarter of length directed slightly mesad; mesal margin with teeth in region of bend, fine serrations basad and distad of teeth; two lateral setae about equal in length, in line along lateral margin of mandible. Frons with two pairs of setae; ventral pair much shorter than dorsal pair (Fig. 38).

Abdomen with anterior tergal plates on segments III to VII dark brown (Fig. 41), each with three to five teeth; posterior part of each plate directly posterad of midline of anterior part of plate in most specimens; anterior part of each plate oval, with anterior margin rounded, anterior part rounded–triangular in few specimens; posterior tergal plate of segment V oval, teeth inserted anterad of thin lighter area near posterior margin of plate. Lateral sclerotized bars on each side of terga II to VIII T–shaped (Fig. 43), bars of most specimens thicker than in *O. avara*. Anal rod as in Figure 45.

Pupae of both sexes 8 mm in length.

Larval and pupal cases. – Larval cases of *O. disjuncta* are tubular, curved slightly posteriorly, and composed of sand grains (Figs. 46, 47). Cases of younger larvae (Fig. 46) are more markedly tapered and curved than those of mature larvae (Fig. 47). The pupal case (Fig. 48) is similar to that constructed by mature larvae except that anterior end of pupal case has a prominent flange. Pupal cases of *O. avara* do not have this prominent flange at the anterior end.

Bionomics. – Larvae of *O. disjuncta* occur primarily in fast flowing boreal streams. Adults were collected in Saskatchewan from June 16 to June 21, and pupae from May 23 to July 17. There is a single generation per year, the larvae overwintering. Adult emergence periods of *O. avara* and *O. disjuncta* overlap but the peak emergence for *O. disjuncta* occurs earlier than for *O. avara*.

Distribution. – *O. disjuncta* is recorded from Saskatchewan in Canada, and from Michigan, South Dakota, Utah, Oregon and California in the United States. In Saskatchewan, *O. disjuncta* is restricted to rivers in the central and northern regions of the province (Fig. 50).

Material examined. – *SASKATCHEWAN* Cold R. at Cold L., 10.VII.1975, 1 larva–30.VIII.1976, 2 larvae; Mistohay Cr. at Hwy. 224, 12.VIII.1975, 3 larva–23.V.1975, 1 larvae, 2 ♂ pupae; Arsenault R. at Hwy. 104, 23.V.1975, 4 pupae, 6 larvae; Englishman R. at Hwy. 26, 2.V.1977, 4 larvae–22.V.1975, 3 ♀ pupae–12.VIII.1975, 8 larvae–21.VIII.1977, 2 larvae–29.VIII.1976, 14 larvae; Waterhen R. at Hwy. 26, 4.V.1977, 9 larvae–23.V.1975, 2 larvae–25.VII.1976, 29 larvae; Waskesiu L., 4.VII.1940, 1 ♀ ; Weyakwin R. at Hwy. 2, 29.VII.1976, 5 larvae; Montreal R., 8.V.1960, 10 larvae–7.VI.1960, 1 larva–22.VIII.1960, 3 larvae; Caribou Cr. at Hwy. 120, 6.VIII.1976, 5 larvae–29.V.1977, 3 ♀ pupae–12.IV.1977, 1 larva–17.VI.1976, 4 ♂ –11.VIII.1977, 1 larva–15.VII.1976, 3 larvae; McDougal Cr. at Hwy. 120, 31.V.1977, 3 larvae, 5 pupae–5.V.1977, 6 larvae–17.VI.1977, 2 ♂ –22.VI.1977, 2 larvae, 2 ♀ pupae, 1 ♂ pupa–7.VIII.1976, 9 larvae–16.VI.1976, 15 ♂ –18.VI.1976, 1 ♀ ,15 ♂ –7.VII.1977, 1 ♂ –21.IX.1976, 13 larvae; Puskwakau R. at Hwy. 106, 10.VI.1975, 1 larva–17.VII.1975, 1 ♂ pupa–6.VIII.1976, 6 larvae; Cub Cr. at Hwy. 106, 29.V.1975, 1 larva; Torch R. at Hwy. 106, 21.IX.1976, 3 larvae; MacKay Cr. at Hwy. 2, 5.VI.1974, 3 larvae–7.VI.1977, 1♀ pupa–8.VI.1977, 1 ♂ pupa, 1 ♀

pupa–21.VI.1976, 1 ♀ –30.VII.1976, 9 larvae–18.VIII.1976, 11 larvae; Waddy R. at Hwy. 102, 3.VII.1975, 2 ♀ ; Creek at mi. 37 of Hwy. 105, 17.VIII.1976, 8 larvae; River at mi. 85 of Hwy. 102, 7.VIII. 1972, 2 larvae; CALIFORNIA–stream near Oregon City, Butte Co., 1.VI.1961, 1 ♂(ROM); OREGON–South Umpqua R. at mouth of Coffee Cr., Rt. 138, s. Kellogg, Douglas Co. 7.VI.1968, 2 ♂ (ROM); Lake Co., Deep Creek 56, 13.VI.1978, 2 ♂ (ROM); Lake Co. Twenty-mile Cr., Site 6+7, 6.VI.1978, 14 ♂(ROM); SOUTH DAKOTA–stream in Spring Cr. Campground, Black Hills near Rapid City, 17.VI.1969, 2 ♂ (ROM); Horse Cr. at Sheridan L., Pennington Co., 8.VI.1961, 5 ♂ (ROM); *MICHIGAN*–Pellston, Emmet Co., west branch Maple R. at Rt. 31, 13.VI. 1972, 2 larvae, 1 pupa (ROM); *UTAH*–Bear R., East Fork For. Campground, Summit Co., 12.VI.1961, 6 , 2 (ROM).

Oecetis avara (Banks)

Setodes avara Banks, 1895: 316. (Type locality: Sherbrooke, Canada). *Oecetina avara Banks,* 1899: 214.

Adults. – Body and wings yellow to light brown, legs yellow. Forewing with spots as in *O. disjuncta*, spots sometimes absent in females. Tibial spur formula 1,2,2. Males 9.5–11 mm, females 7–10 mm in length.

Male genitalia with segment IX annular; in lateral aspect (Fig. 3), dorsal half wider than ventral half, setae on lateral surface not as numerous as in *O. disjuncta*; sternum, in ventral aspect (Fig. 13), with large membranous area; cercus (Fig. 3) with dorsal surface convex, ventral surface concave. Clasper (Fig. 3) with dorsal margin rounded, posterior margin deeply incised, shallowly incised in few specimens; ventrocaudal lobe prominent, not as prominent in few specimens; ventromesal margins of both claspers widely separated at base (Fig. 13). Segment X (Fig. 11) with pair of lightly sclerotized triangular lateral lobes; mesal process composed of single elongated, sclerotized lobe, apex of lobe entire (Fig. 11) or shallowly incised (Fig. 10). Aedeagus, in lateral aspect (Fig. 4), curved posteroventrad; in caudal aspect (Figs. 6, 8) aedeagus asymmetrical, apicodorsal surface with distinct sclerotized areas; inner sclerotized ring asymmetrical (Fig. 8).

Female genitalia with lateral sclerite of segment IX, in lateral aspect (Fig. 17), narrow, with prominent ventrocaudal lobe; lobe extended beyond caudal margin of sternum IX (Fig. 15); latter with ventral surface in form of raised, flattened oval area (Fig. 15); pattern on oval area much lighter and less distinct than in *O. disjuncta*; oval area bordered by dark area laterally and anteriorly. Cercus, in lateral aspect (Fig. 17), rounded, triangular, not extended beyond segment X. Claspers and segment X (Fig. 17) as in *O. disjuncta.* Bursa copulatrix as in Figure 15.

Larva. – Dorsum of head yellow (Fig. 19); muscle scars indistinct; darker in color and contrasted with ground color of head in few specimens. Posterolateral and posterodorsal areas of head white (Fig. 22). Cephalic seta 13 (Fig. 19) directly below midpoint between seta 14 and 15; seta 17 directly posterad of seta 16. Frontoclypeal apotome with linear pale area between each anterolateral corner and rest of sclerite (Figs. 19, 20). Labrum (Fig. 28) with convex lobe on either side of mesal indentation; margin of lobe entire; numerous secondary setae on anterior portion of dorsum; venter with pair of setae near lateral margin and single seta near anterior margin on each side, some small spine–like hairs near anterior seta on left side, prominent comb of spines near posterior margin, spines as in Figure 29. Mandibles (Fig. 27) single bladed, prominent serrations on mesal surface basad of subapical teeth. Sclerite on dorsal surface of submentum V–shaped or U–shaped, point of V or U directed posterad. Ventral apotome (Fig. 24) yellow, rectangular, much wider than long (width/length ratio values 3.14 – 8; $\bar{x}$ =4.48; n = 37); lateral margins rounded, anterolateral extensions present. Pair of triangular sclerites posterad of caudal margin of ventral apotome.

Thorax similar to *O. disjuncta* (Fig. 32). Pronotum with light yellow transverse band anteriorly, darker transverse band in middle, posterior portion white, marked by few light brown spots. Each mesontal sclerite dark yellow anteriorly, white posteriorly, single seta near anteromesal corner, as many as 19 setae on anterior and lateral portions of sclerite, three setae on middle of sclerite. Metanotum with sa2 and sa3 each of single seta. Structure of trochantin of propleuron as in *O. disjuncta*, as many as seven setae on dorsal surface. One to three setae on mesoepisternum; one seta on mesoepimeron. As many as seven setae on metaepisternum; one seta on metaepimeron. Foreleg (Fig. 35) without secondary setae on ventral surface of basal part of trochanter; anterior surface of apical part of trochanter with two stout spine–like setae on ventral surface, two setae near distal oblique margin of trochanter; setae on dorsal surface of femur shorter relative to femur width than in *O. disjuncta*; tibia with single spine–like seta on distal portion of anterior surface; claw about as long as tarsus. Midleg with few spine–like setae and finer setae on ventral surface of femur; most setae on dorsal surfaces of femur and tibia shorter than in *O. disjuncta*; claw shorter than tarsus, basal seta well developed. Hindleg (Fig. 36) with most setae on dorsal surfaces of femur and tibia shorter than in *O. disjuncta*; tibia and tarsus each with spine–like setae on ventral surface; claw shorter than tarsus, basal seta well developed. Mesosternum without setae, metasternum with pair of setae.

Abdomen with anterior gills on segments II to VI or VII dorsally and ventrally; one pair of pleural gills on segement II; in few specimens, gill on dorsal surface of lateral lobe of segment I. Two groups of hooked spines at tip of median dorsal lobe of segment I as in *O. disjuncta*. Segment IX with seta on each side of tergum near lateral margin, posterior margin of tergum with six large and four small setae. Hairs and spines sparse on surface of caudal end of abdomen. Claw of anal proleg with two dorsal denticles.

Mature larvae 6.5 – 9 mm in length.

Pupa. – Anterior surface of head with two pairs of setae subequal (Fig. 39). Abdomen with anterior hook–bearing plates on terga of segments III to VII (Fig. 42) yellow to light brown; anterior portion of each plate triangular, anterior end of triangle in most specimens directed laterad of midline of posterior portion of plate. Lateral bars on terga of segments II to VIII (Fig. 44) in most specimens not as wide as in *O, disjuncta*. Other features of *O. avara* pupa similar to those already described for pupa of *O. disjuncta*.

Male pupae 6 – 9 mm in length, female pupae 6 – 7 mm.

Larval and pupal cases. – The larval case of *O. avara* is similar to that of *O. disjuncta*. Some pupal cases of *O. avara* (Fig. 49) have some sand grains attached around the rim of the anterior end of the case but the case lacks the prominent flange at the anterior end characteristic of those of *O. disjuncta*.

Bionomics. – Larvae of *O. avara* inhabit turbid waters of the Saskatchewan River system as well as clear, fast–flowing streams in the boreal forest region of Saskatchewan. In Saskatchewan, adults of *O. avara* were collected from June 16 to August 12. In cooler boreal streams, pupae of *O. avara* were collected from May 29 to July 15. This species is univoltine in these streams. In the warmer waters of the Saskatchewan River system *O. avara* pupae were collected in mid-summer and in fall, which suggests that this species is bivoltine in these warmer waters. The larva is the overwintering stage in this species.

Distribution. – *O. avara* is recorded throughout North America, from southern Canada to Mexico (Ross, 1944). However, all previously published records are suspect since specimens of *O. disjuncta* may have been incorrectly identified as *O. avara* in previous publications. In this study we examined specimens of *O. avara* from Saskatchewan and Ontario in Canada, and

from Idaho and Montana in the United States.

In Saskatchewan *O. avara* larvae live in the main branches of the Saskatchewan River system and are also common in streams in the boreal forests of the central region of the province (Fig. 50) but they are absent from northern Saskatchewan.

Material examined. – SASKATCHEWAN South Saskatchewan R., 1/4 mi. upstream from the Queen Elizabeth Power Station, 11.VI.1972, 1 ♀ pupa–10.VII.1972, 8 ♂–12.VII.1971, 1 ♂–13.VII.1971, 1 ♂, 2 ♀ –15.VII.1972 4 ♂ , 1 ♀ –19.VII.1971, 2 ♂ –23.VII.1972, 1 ♂ –15.VII.1971 1 ♂ ;South Saskatchewan R., ferry e. of Hague, 21.VI.1972, 1 ♂ –4.VII.1972, 4 ♂ ; South Saskatchewan R., ferry no. of Birch Hills, 26.V.1972, 7 larvae–25.V.1973, 10 larvae–7.VI.1972, 2 ♂ pupae, 2 ♀ pupae, 2 larvae–12.VI.1972, 1 ♀ pupa, 13 ♂ –24.IV.1973, 4 larvae–6.VII.1972, 2 ♂ , 1 ♀ –21.IX.1972, 1 larva–20.VI.1973, 12 larvae–18.VII.1972, 1 ♀ –17.VIII.1971, 6 larvae–8.V.1973 1 larva; South Saskatchewan R., ferry n. of Lemsford, 14.VII.1971, 3 ♂ pupae, 2 ♀ pupae–12.VII.1972, 2 ♀ , 2 ♂ , 3 ♂ pupae, 3 ♀ pupae–24.VII. 1972, 2 ♂ pupae, 3 ♀ pupae, 1 larva–6.IX.1972, 1 ♀ pupa–27.IX.1972, 1 larva–25.VI.1972, 1 larva; North Saskatchewan R., ferry 10 mi. e. of Prince Albert, 14.IX.1972, 2 larvae–17.V.1972, 1 larva–15.VI.1972, 13 ♂ , 5 ♀ –21.IX.1972, 1 larva–15.VI, 1972, 1 ♀ ; North Saskatchewan R. at Hwy. 3, 23.VI.1972, 9 ♂ , 7 ♀ ; North Saskatchwan R. at Hwy. 5, 23.VIII.1972, 10 larvae; North Saskatchewan R., Prince Albert, 20.VI.1973, 1 ♂ pupa; Montreal R. at Hwy. 2, s. of La Ronge, 27.VI.1972, 7 ♂ , 3 ♀ , 1 larva–11.VI.1976, 6 ♂ , 5 ♀ –16.VI.1971, 6 ♂ –19.VI.1976, 1 ♂ ; Montreal R., 28.V.1969, 1 larva–20.VII.1960, 1 ♂ –15.VII.1960, 1 larva–28.VII.1960, 5 larvae–22.VI.1960, 5 larvae–11.VIII.1960, 16 larvae; Montreal R. at outflow of Bigstone Lake, 4.V.1977, 2 larvae–10.VI.1976, 3 larvae–6.VII. 1977, 1 larva, 4 pupae; Nipekamew R. at Hwy. 165, 16.VII.1975, 1 ♂ , 1 ♀ –13.VII.1976, 2 ♂ , 3 ♂ pupae, 1 ♀ pupa, 5 larvae; Weyakwin R. at Hwy. 2, 28.VI.1976, 11 ♂ –11.VI.1976, 2 larvae, 4 pupae–16.VI.1976, 1 ♂ –4.VII.1975, 1 larva–11.VII.1976, 1 ♂ pupa, 1 ♀ pupa–14.VII.1974, 1 ♀ , 1 ♂ –16.VII.1975, 3 ♂ , 2 ♀ ; Caribou Cr. at Hwy. 120, 29.V.1977, 3 ♂ pupae, 17 larvae–17.VI.1977, 1 ♀ pupa, 2 larvae–12.IV.1976, 3 larvae–16.VII.1977, 1 ♂ , 1 ♀ –23.VI.1977, 9 ♂ , 12 ♀ , 3 larvae–17.VI.1976, 3 ♂ , 2 ♀ , 5 larvae–27.VI.1977, 1 ♂ pupa–13.VII.1977, 28 ♂ , 16 ♀ , 1 ♂ pupa–15.VII.1976, 1 ♂ pupa, 1 ♀ pupa, 35 ♂ , 28 ♀ , 5 larvae–7.VII.1977, 1 larva, 2 ♂ pupae, 1 ♀ pupa–23.VI.1977, 1 ♂ pupa, 1 ♂ , 2 ♀ –6.VIII.1976, 4 ♂ , 9 larvae–27.VI.1977, 1 prepupa–15.VII.1976, 3 prepupae–17.VII.1976, 1 larva; Crean R. at Hwy. 2, 9.VI.1976, 1 ♂ pupa; Torch R. at Hwy. 106, 26.IV.1977, 1 larva–16.VI.1976, 2 ♂ –2.VII.1975, 1 ♂ –15.VII.1976, 1 ♂ , 2 ♀ –5.VIII.1976, 4 ♂ , 2 larvae–21.IX.1976, 8 larvae; Mistohay Cr. at Hwy. 224, 10.VII.1976, 38 ♂ , 15 ♀ , 1 larva–11.VII.1976, 1 ♂ pupa–12.VIII.1975, 1 ♂ ; Broad Cr. at Hwy. 104 2.VII.1975, 1 ♂ , 1 ♀ ; Overflow R. at Hwy. 109, 11.VI.1975, 2 larvae Overflow R., 1958, 1 larva; Taggart Cr. at road to Dore L., 26.VI.1976, 1 ♀ pupa; ONTARIO –Streetsville, Credit River, Peel Co., 23.VII.1952, 4 ♂ , 34 ♀ (ROM): MONTANA– Yellow Bay, Flathead L., 26.VII.1965, 1 ♂ ; Missoula Co., Owl Cr., Stn. #4, between Placid L. and Clearwater R., 9.VIII.1973, 13 ♂ , 41 ♀ (ROM); IDAHO– 20 mi. s. of Mack's Inn, Fremont Co., 10.VII.1969, 37 ♂ , 3 ♀ (ROM).

DISCUSSION

The taxonomic status of *O. disjuncta* has been misunderstood for more than 30 years, for several reasons. First, the description and drawing of the male genitalia of *O. disjuncta* provided by Banks (1920) were inadequate to permit specimens of *O. disjuncta* to be distinguished from specimens of *O. avara*. Second, specimens of the two species are extremely similar morphologically and, even if one can compare type specimens, without a large collection of males of both species to compare with the types it would be difficult to determine the proper taxonomic status of *O. disjuncta*. Third, since Ross (1944) and Denning (1956) suggested that *O. disjuncta* was likely conspecific with *O. avara*, taxonomists have not concerned themselves with clarifying this problem. Specimens of *O. disjuncta* were probably regarded as variants of *O. avara*.

Preliminary evidence suggests that specimens of *O. disjuncta* have previously been identified as *O. avara*. As indicated here, both species are widely distributed in North America, and it seems likely that they are abundant not only in Saskatchewan but, also in many other regions of North America. However, while published records for *O. avara are numerous, none exist for O. disjuncta*, except for the type localities. Specimens of *O. disjuncta* have probably been collected but, since they are not published under this or any other name, these specimens must have been identified as *O. avara*. Our study of specimens of *O. avara* from the ROM support this

conclusion. Of 11 vials labelled *O. avara*, lent by the ROM, eight contained specimens of *O. disjuncta*. If misidentifications of specimens of *O. disjuncta* have, indeed, occurred, then some of the published records for *O. avara* are probably incorrect.

Among specimens of the *O. avara* complex which we studied, two species are recognizable: *O. avara* and *O. disjuncta*. However, study of the *O. avara* complex is not complete because we examined specimens from only a limited number of North American localities. Taxonomists should continue careful study of specimens collected at other localities, to determine if additional species are attributable to this complex, or if the morphological differences between *O. avara* and *O. disjuncta* are as clear at these localities as is reported in our study.

DISPOSITION OF MATERIAL

Some adult, larval and pupal specimens of the two *Oecetis* species examined in this study will be deposited in the Royal Ontario Museum, Toronto, and in the Canadian National Collection, Ottawa. The remainder are in the authors collections, or in the collection of the Entomology Museum, Biology Department, University of Saskatchewan, Saskatoon, Saskatchewan.

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Thanks go also to Dr. Alfred Newton of the Museum of Comparative Zoology for loan of type specimens of *O. avara* and *O. disjuncta*.

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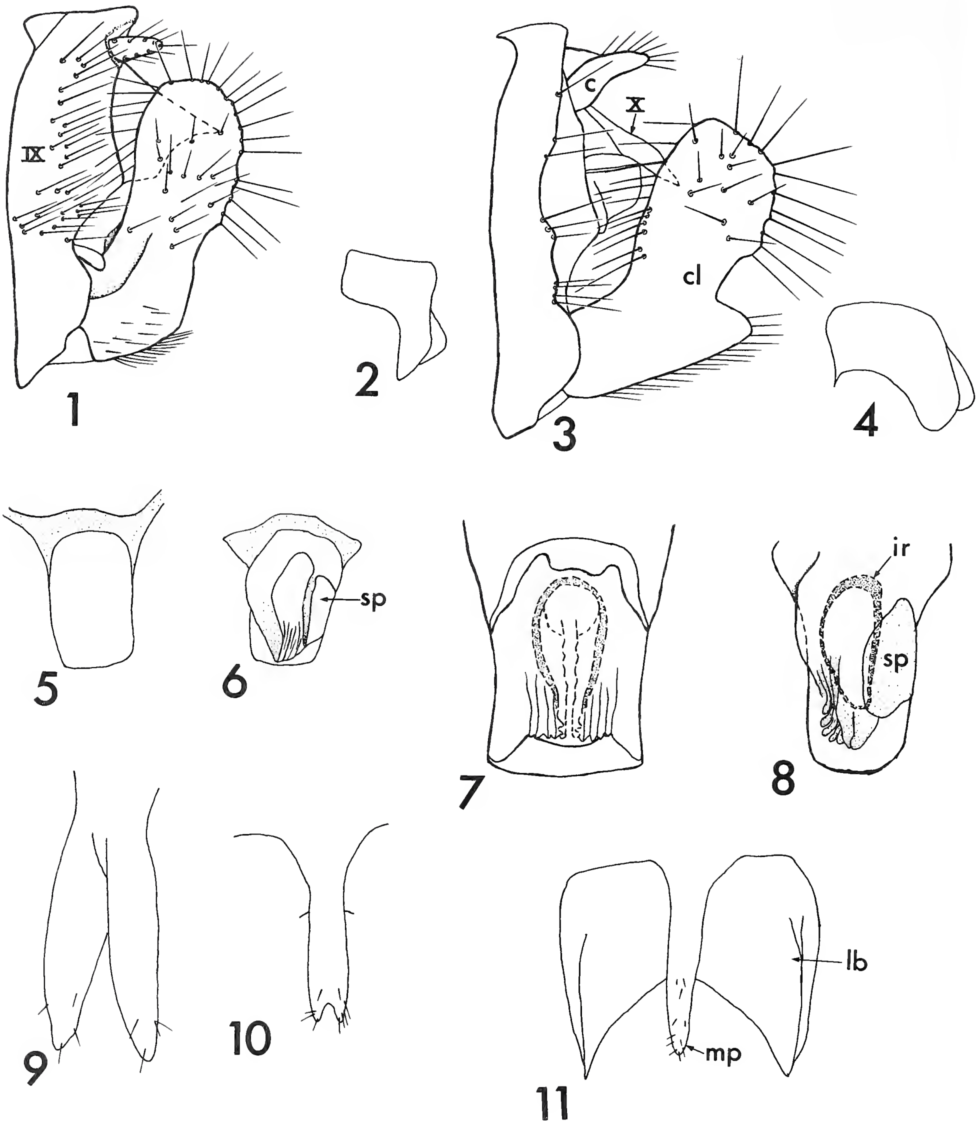

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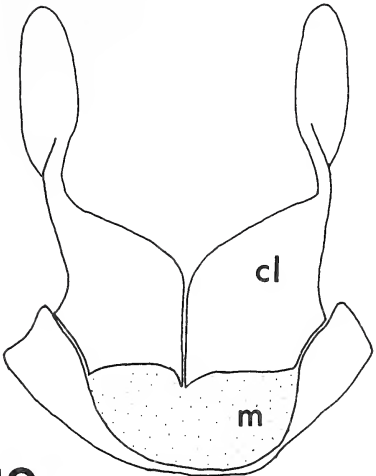

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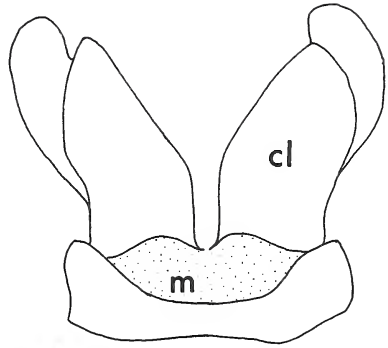

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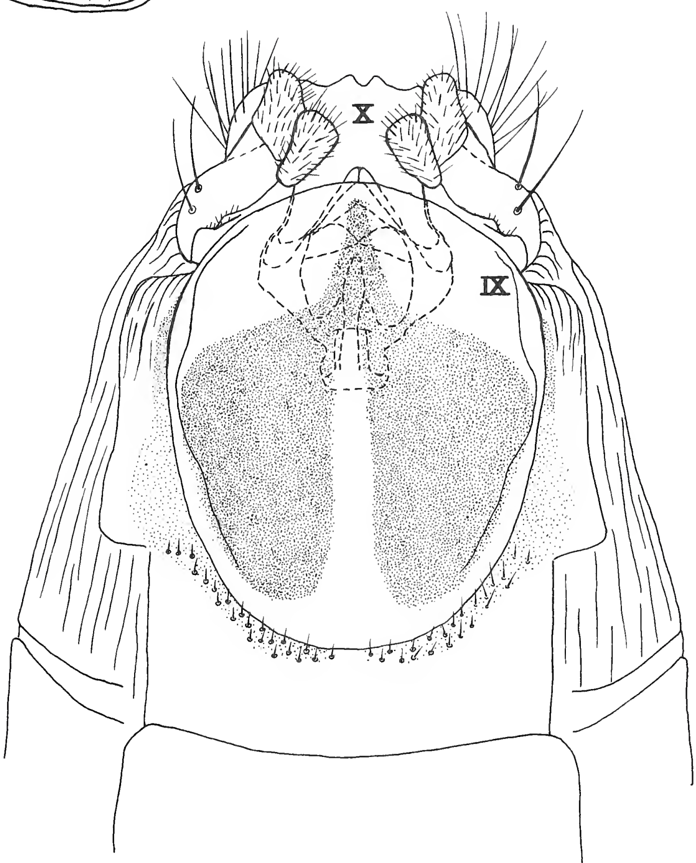

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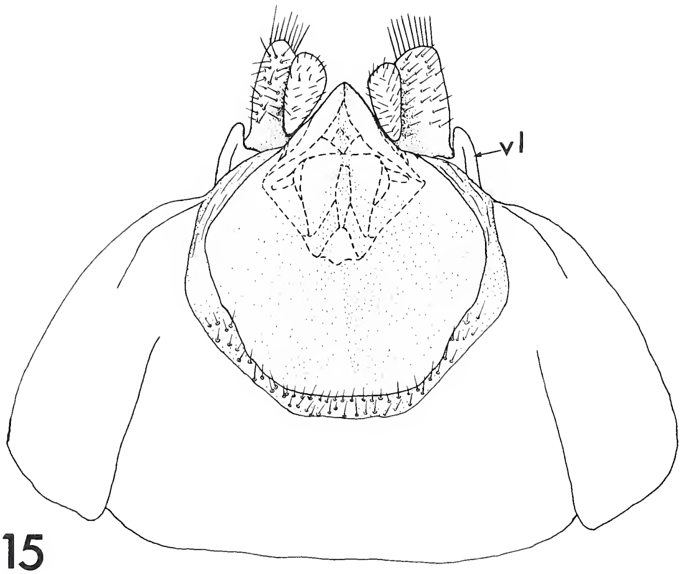

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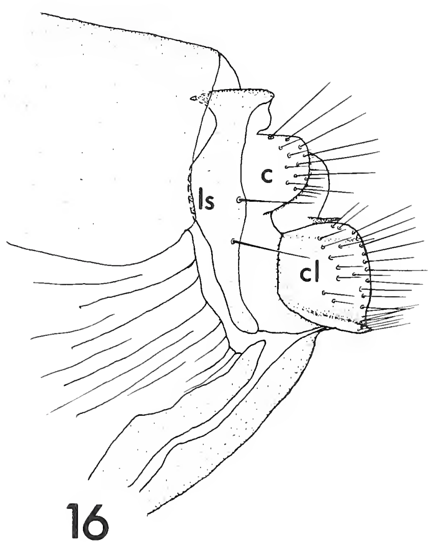

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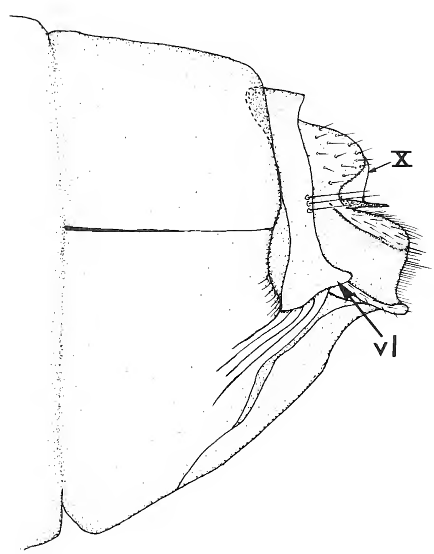

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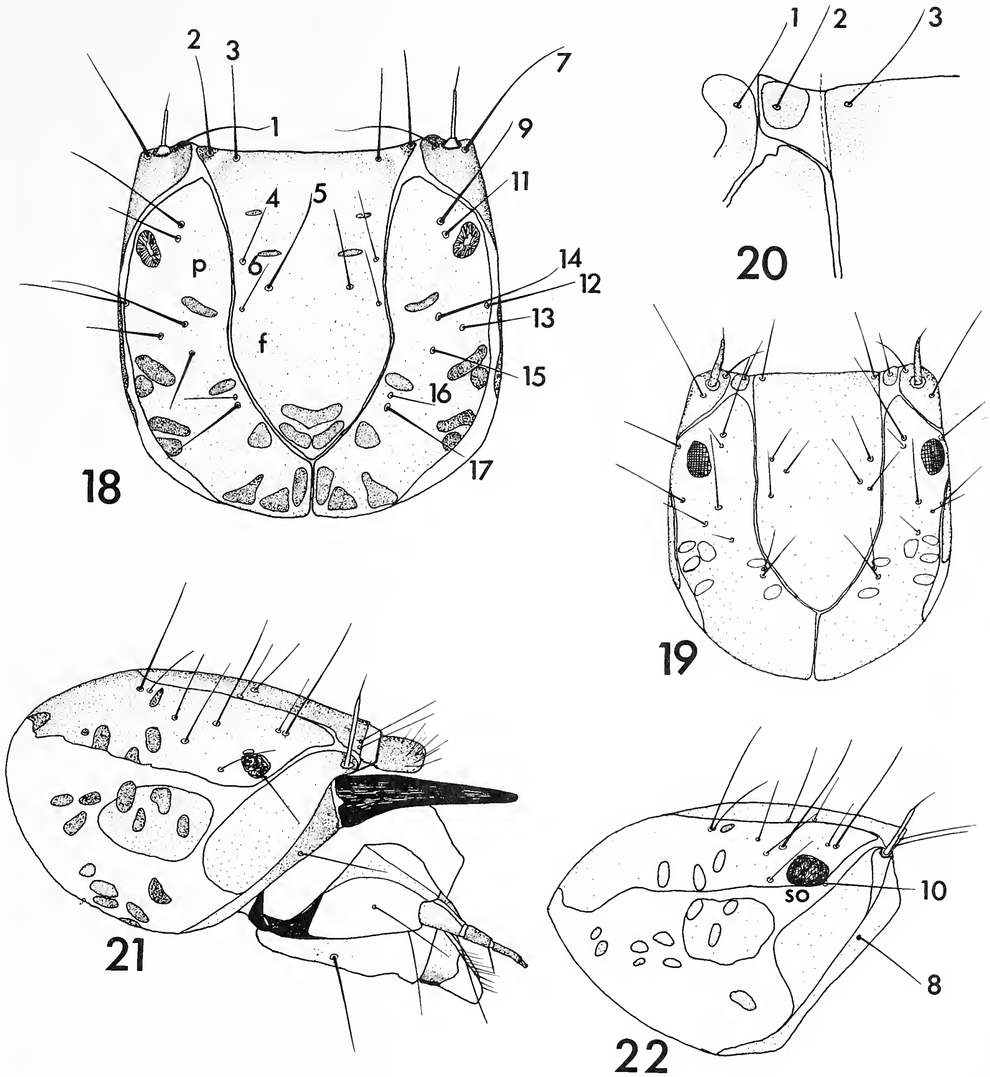

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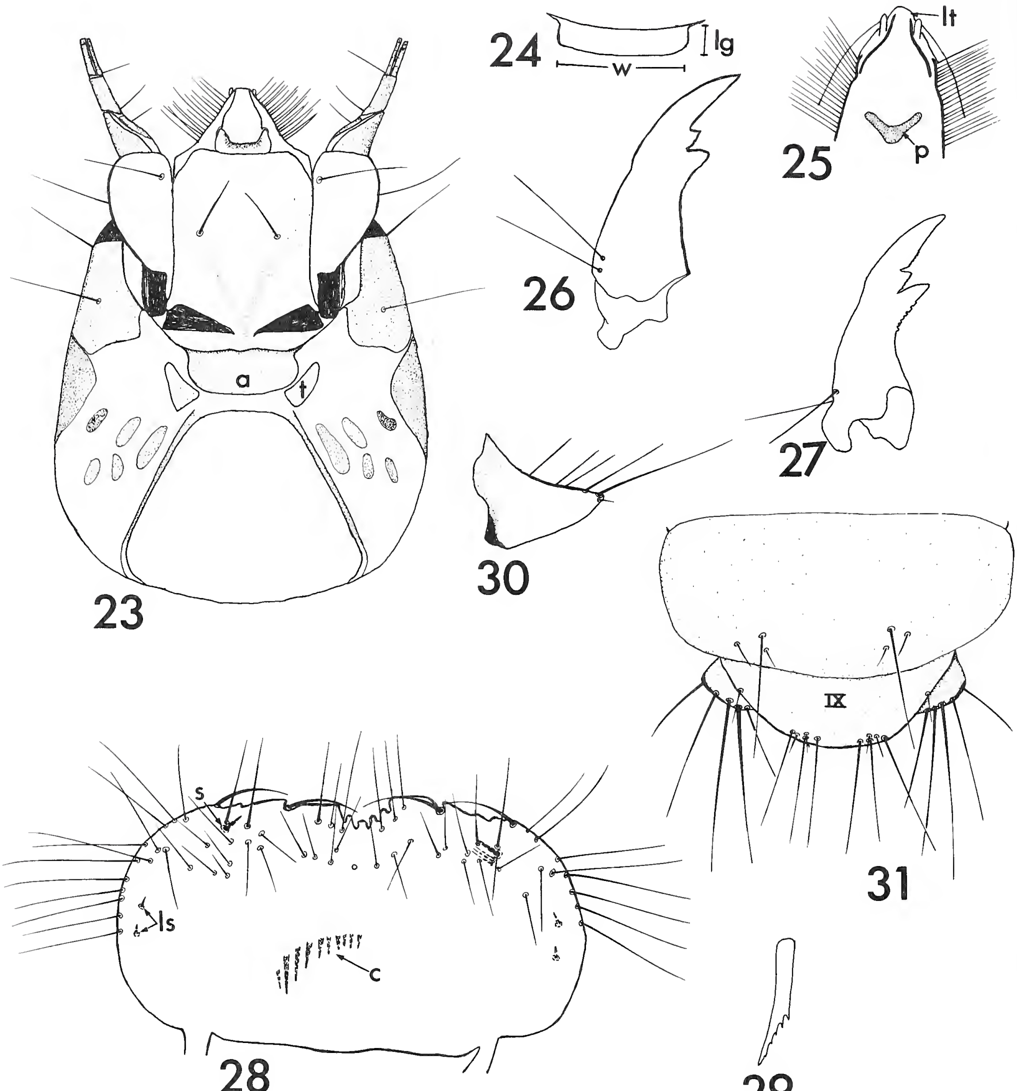

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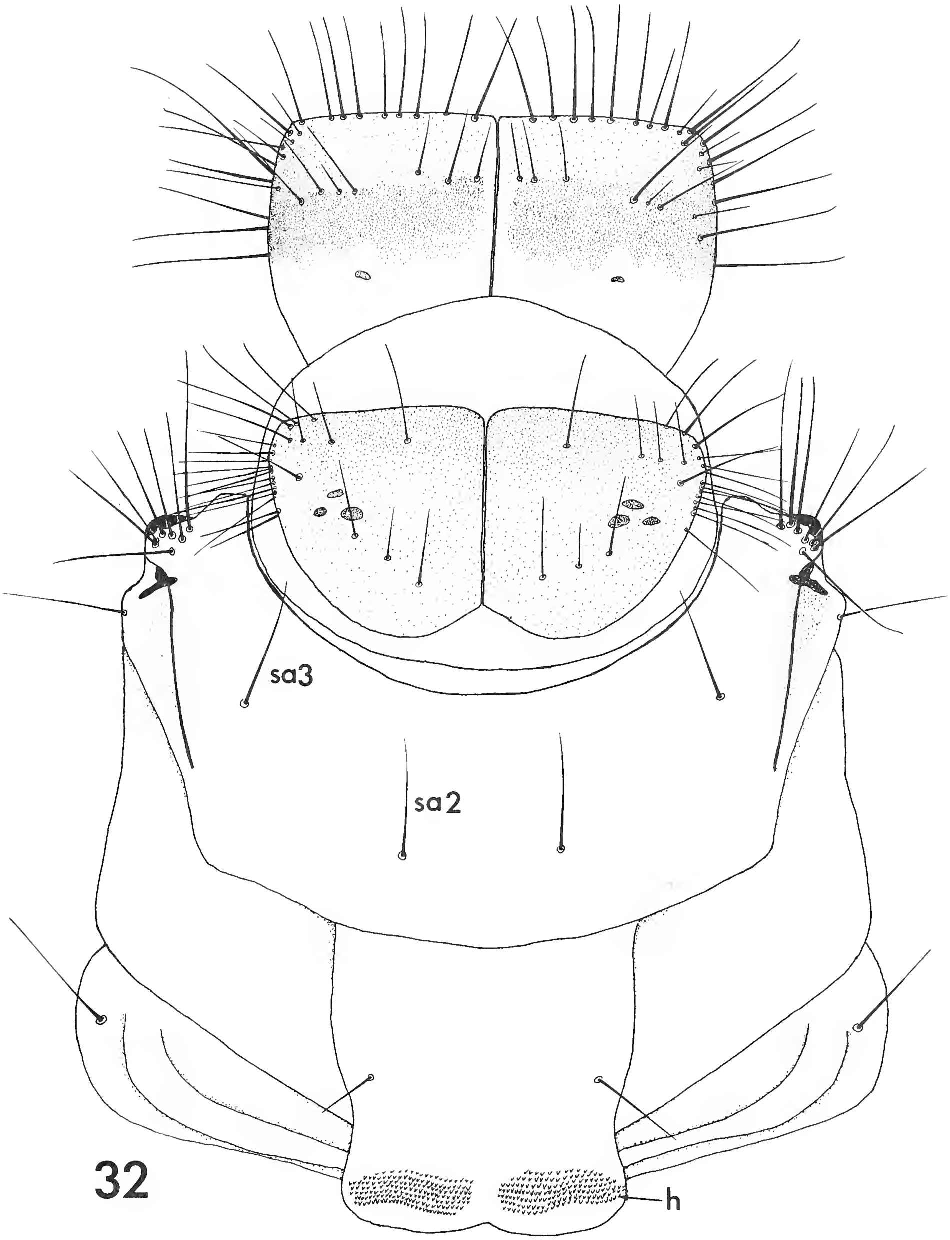

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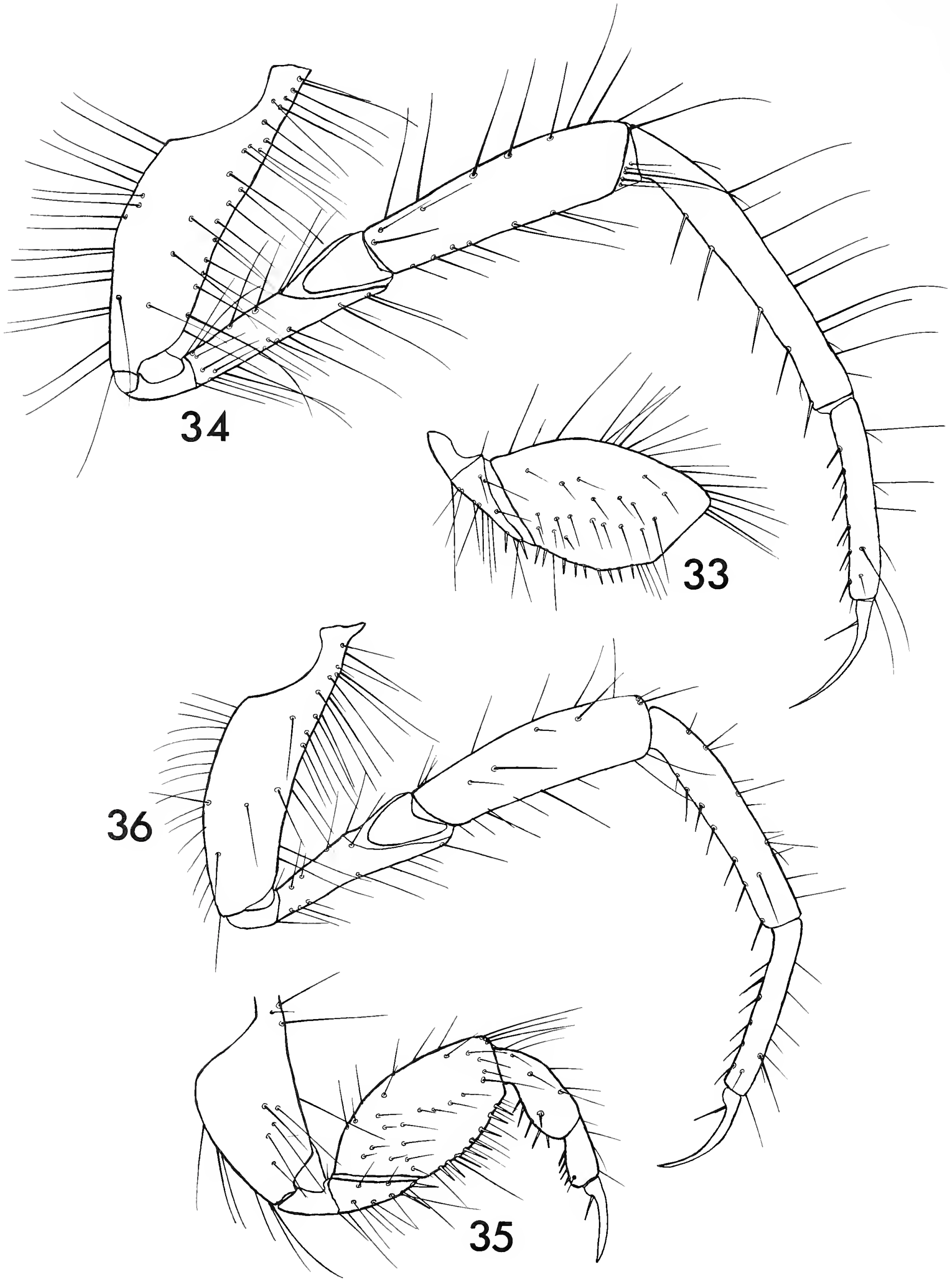

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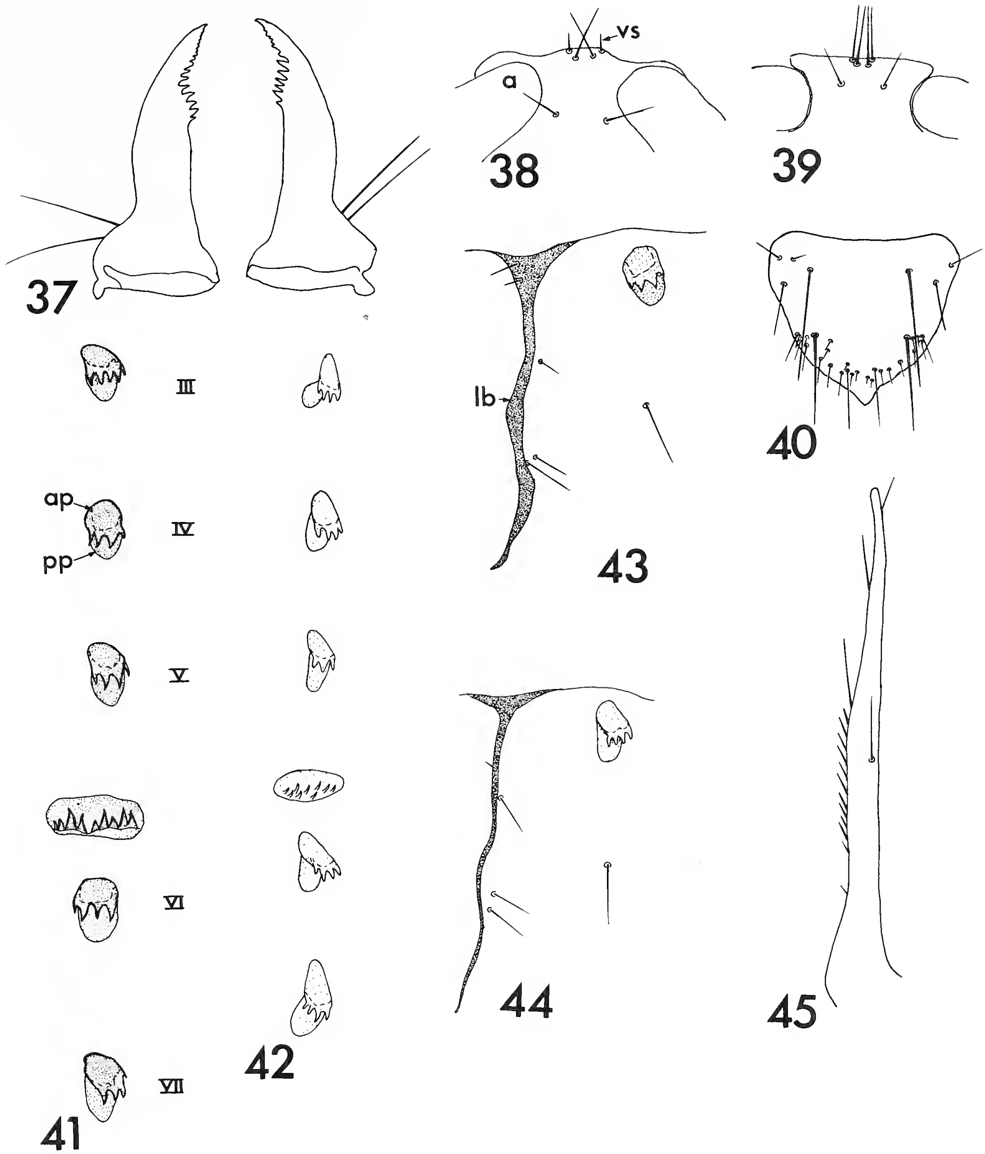

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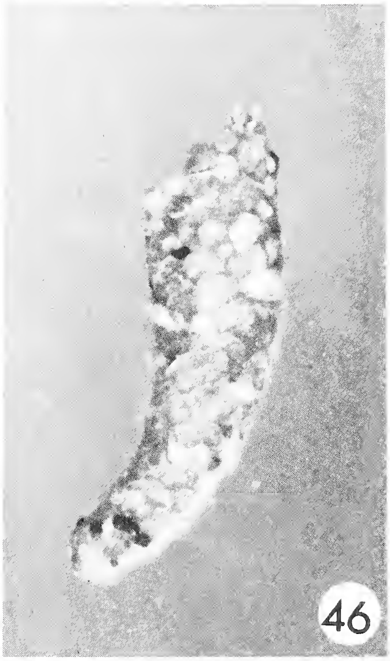

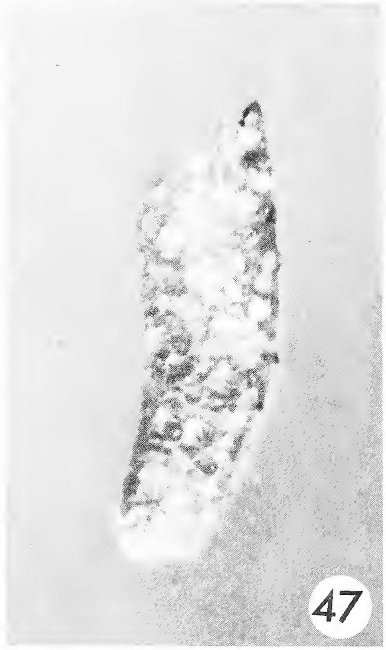

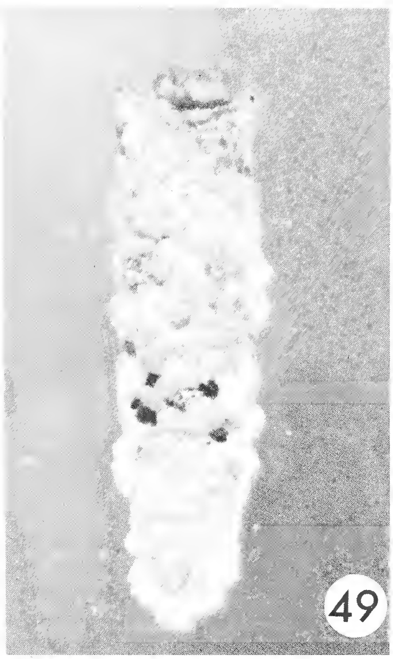

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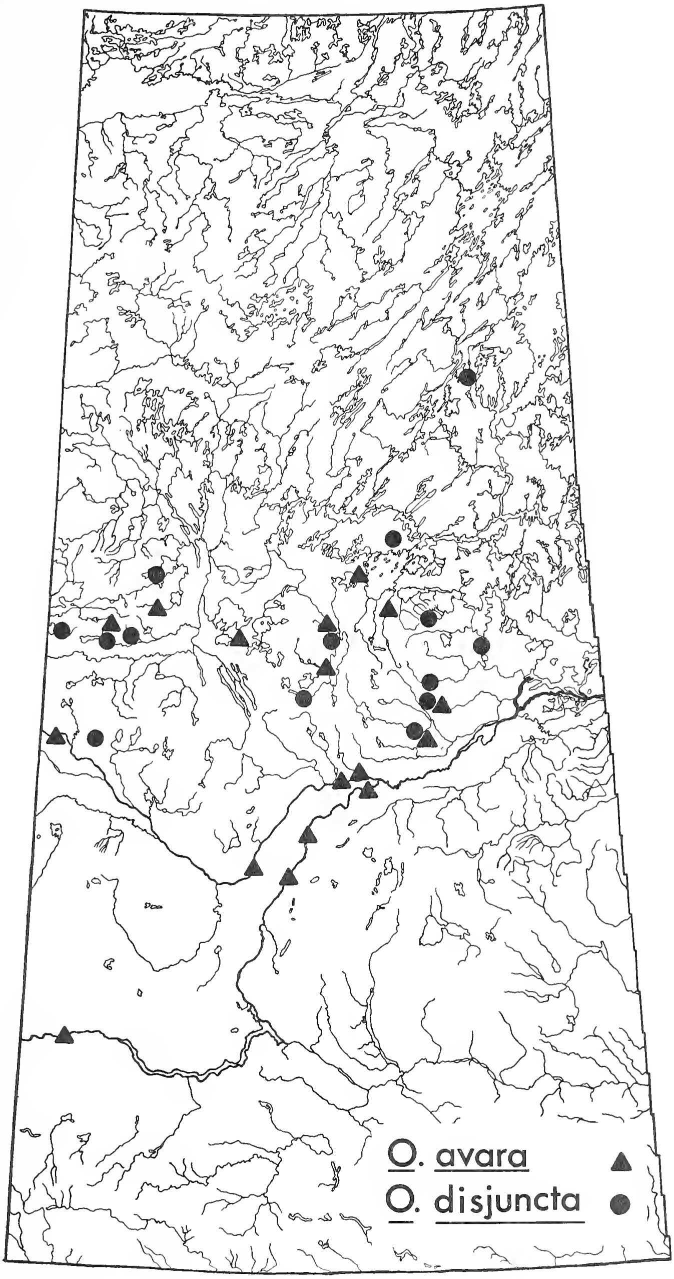

Fig. 50. Distribution of *Oecetis disjuncta* (Banks) and *Oecetis avara* (Banks) in Saskatchewan.

THE EFFECT OF HYDROELECTRIC DAMS AND SEWAGE ON THE DISTRIBUTION OF STONEFLIES (PLECOPTERA) ALONG THE BOW RIVER

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ABSTRACT

Adult stoneflies (Plecoptera) were collected from 17 sites along 346 km of the Bow River. Of 59 species collected in the study area, 43 were relatively common. Although a few species were found throughout most of the study area, many had relatively narrow distribution limits. An ordination technique differentiated four species associations. One of these associations was in the subalpine and montane vegetation zones, one near the boreal zone, and two were in the grassland zone. Sewage effluent from small towns had little or no effect on distribution of stonefly species, but hydroelectric dams and sewage effluents from a large city reduced the species diversity and abundance of Plecoptera. Two species were apparently eliminated from over 150 km of river by dams and by sewage from the city of Calgary, while the distribution of some species was not reduced appreciably by these factors.

Des "mouches de pierres" adultes (Plecoptera) ont été collectionnées dans 17 localités réparties sur 346 km le long de la rivière Bow. Parmis 59 espèces collectionnées au cours de cette étude, 43 étaient relativement communes. Si quelques espèces furent trouvées dans la plus grande partie de la région étudiée, de nombreuses espèces présentent une distribution réduite. Quatre associations ont été identifiées a l'aide d'une technique d'ordination. Une de ces associations existaient dans la zone subalpine et dans la zone à vegetation montagneuse, une autre fût identifiée dans la zone boréale, et les deux autres dans la zone des prairies. Les effluents d'égouts des petites villes ont peu ou n'ont pas d'effet sur la distribution des espèces de Plécoptères; par contre les barrages hydroeléctriques ainsi que les effluents d'egouts des grandes citées influencent sensiblement la diversité et l'abondance des espèces. Les barrages et les eaux d'égouts de la ville de Calgary ont apparemment éliminé deux espèces sur 150 km le long de la rivière; ces facteurs ne semblent pourtant pas réduire de maniere évidente la distribution de certaines autres espèces.

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INTRODUCTION

Sequential changes in distribution of Plecoptera as well as other aquatic insects along rivers has been documented in Europe (Berthelémy 1966, Kamler 1967) and in North America (Dodds and Hisaw 1925, Donald and Anderson 1977, Knight and Gaufin 1966). The principal objective of this present study was to describe distribution and associations of Plecoptera along the Bow River, and to identify distributions that have been altered by human activity in the watershed. This river is controlled by four hydroelectric dams, and several small towns and a major city discharge sewage into the river.

For many North American aquatic insects, including Plecoptera, identification of immature stages cannot be made below generic level (Wiggins 1966, Hynes 1970, Cummins 1974). Because most adult stoneflies do not disperse far from the shoreline of rivers, we used quantitative collections of adult stoneflies to give an estimate of abundance and distribution of aquatic stages.

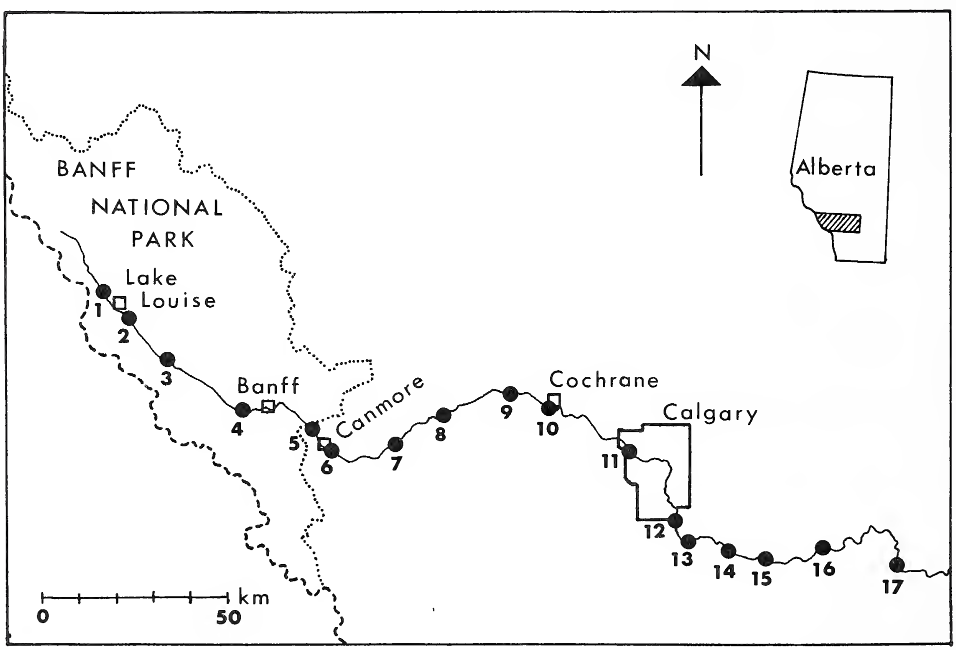

Figure 1. Map of study area showing the location of seventeen collecting sites on the Bow River.

METHODS

At the beginning and middle of each month, adult stoneflies were collected for 30 minutes along approximately 0.5 km of shoreline at each of 17 sites on the Bow River (Fig. 1). Collections were made in 1976 and 1977 from March to October. At one station, located within the city limits of Calgary, stoneflies were collected on a weekly basis, although only data compiled from the bimonthly samples were used in the main part of this paper. At each site vegetation was swept with an insect net, rocks along the shoreline were overturned and examined, and overhanging banks and bases of trees were checked for stoneflies. Because comparable sampling efforts were made at each site, these collections were presumed to be semi-quantitative relative to other sites. All specimens collected were preserved in the field in 70% ethanol. Identifications were made primarily with the aid of keys by Gaufin *et al.,* (1972). Scientific nomenclature follows that of Baumann *et al.,* (1977).

Mean specific conductance, and mean total coliform bacteria values were calculated from unpublished data provided by Environmental Protection Service, Alberta Environment and by Water Quality Branch, Environment Canada. Approximate locations of sites where measurements of water quality were taken can be determined from Fig. 2. Number of samples taken at each site ranged from 13 to 77 for specific conductance, and from 10 to 30 for total coliform bacteria counts. Daily discharge readings were taken at six sites on the Bow River, and at 12 sites on the larger tributaries of the Bow (Water Survey of Canada 1974). Number of years for which daily measurements were taken at these gauging stations ranged from three to 65.

Stonefly associations at the 17 sites along the Bow River were analysed with the Bray-Curtis polar ordination method (Whittaker 1973). The total number of each species collected at a site was determined. These abundance values were then converted to a percent of the total number of stoneflies collected at each site. The percent values were then used to determine similarity of the fauna at each site with the fauna of the other 16 sites. The most dissimilar sites became poles of the axes along which other sites are arranged.

THE STUDY AREA

The Bow River originates on the Continental Divide in Banff National Park and flows in a south-easterly direction through much of southern Alberta. The extreme upstream site (site 1) has a mean annual discharge of approximately 8.5 m$\propto$/s and is about 35 km from the headwaters of the Bow River. The last site is 346 km downstream where mean annual discharge is about 109 m$\propto$/s (Fig. 2). Over this 346 km distance the river passes through four vegetation zones (Rowe 1972): subalpine, montane, boreal, and grassland. In general, mean annual temperature increases downstream, while mean annual precipitation decreases. Maximum summer water temperatures at the furthest upstream and downstream sites are about 13°C and 23°C respectively. The Bow River is frozen over between December and March, but actual time of freeze-up and break-up at a given site depends on elevation, year, gradient, and distance from sewage outfalls or hydroelectirc dams.

Gradient of the Bow River in the study area is approximately 2.05 m/km and only few relatively short stretches have a gradient noticeably different from this (Fig. 3). At each

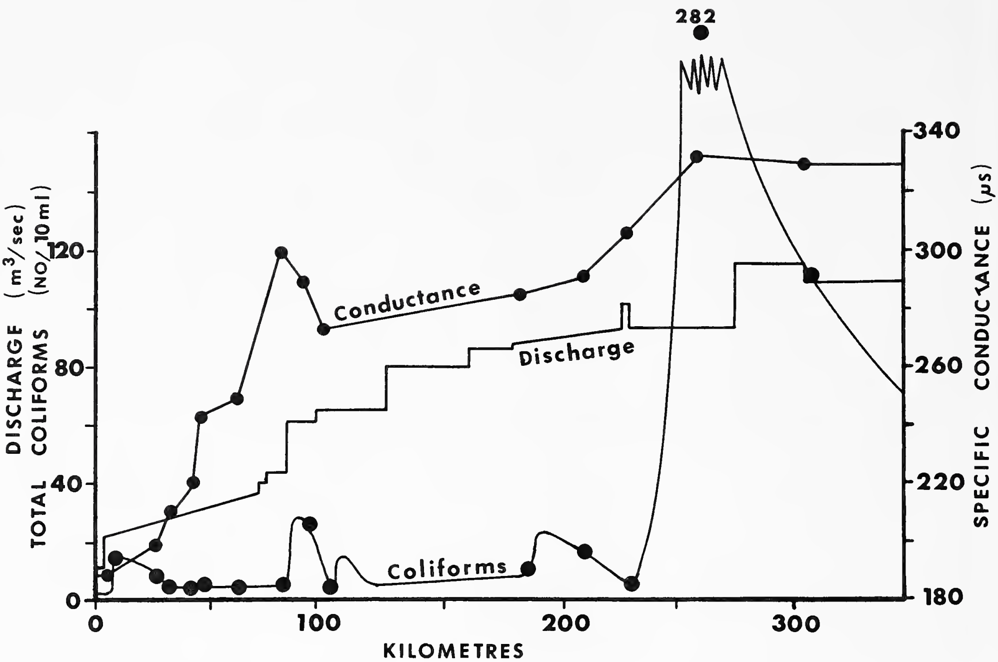

Figure 2. The specific conductance, mean annual discharge, and total coliform bacteria for the Bow River. A decrease in discharge shows location of weirs where water is taken for irrigation.

collecting site, areas of sand, gravel, and boulders were present.

The major dissolved constituents of the river water are bicarbonates of calcium and magnesium. Concentrations of common anions and cations increase in the downstream direction, similar to increase in specific conductance shown in Fig. 2. Oxygen concentrations were near saturation throughout the study area. The lowest oxygen concentration, 7.5 mg/l, was recorded downstream from Calgary.

Bow River water is used for town and city waterworks, generating electrical power, and irrigation purposes. Along the river are four towns and one city (Fig. 1). Lake Louise and Banff are resort towns, and their total population is usually much larger than number of permanent residents indicated in Fig. 3. Sewage discharged into the Bow River from towns and the city increases abundance of total coliform bacteria in the river (Fig. 2).

The four dams on the Bow River are used for generating electrical power (Fig. 3). The two upstream dams and the one furthest downstream have relatively constant daily discharge patterns, but the other dam has a variable daily discharge.

RESULTS

During this study, we collected a total of 4,372 specimens representing 59 species. Of these, 16 species were represented by a single specimen or were found at only one site. These 16 species were *Oemopteryx fosketti* (Ricker), *Zapada frigida* (Claassen), *Paraleuctra forcipata* (Frison), *Capnia gracilaria* Claassen, *Capnia petila* Jewett, *Alloperla serrata* Needham and

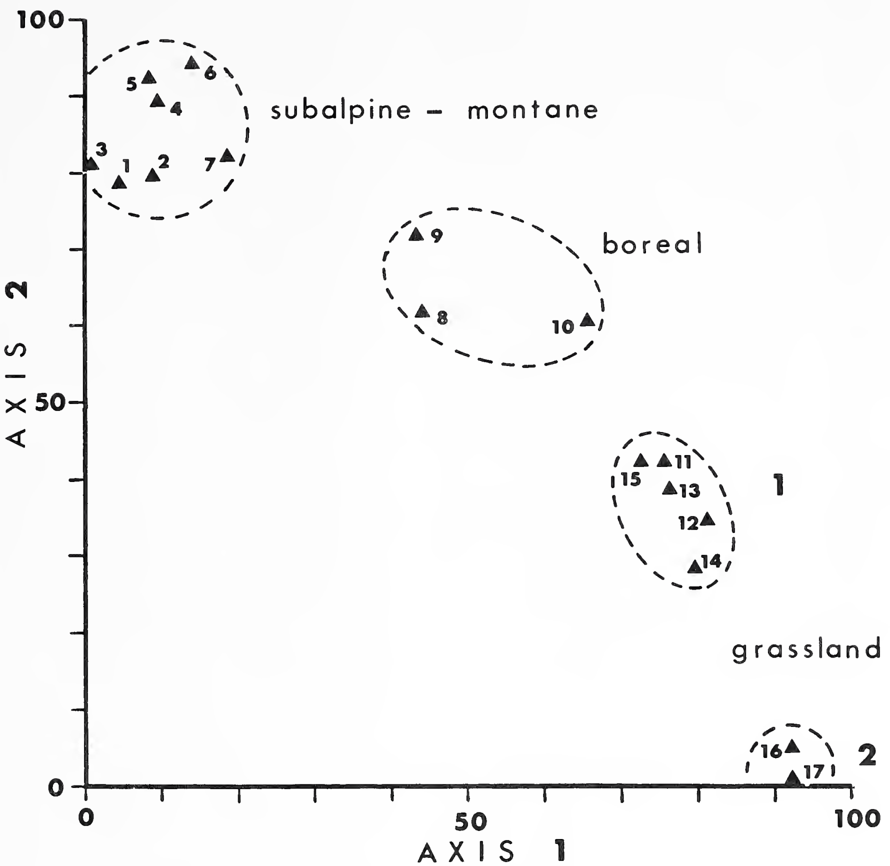

Figure 3. The gradient, number of species, and abundance of Plecoptera at seventeen sites on the Bow River. Dark triangles show location of hydroelectric dams. Vertical and horizontal bars show location and resident population of towns and city (see Fig. 1). Dotted lines indicate areas where species diversity and stonefly abundance would reach zero because of presence of reservoirs or sewage outfalls.

Claassen, *Sweltsa borealis* (Banks), *Malenka flexura* (Claassen), *Perlomyia utahensis* Needham and Claassen, *Isocapnia grandis* (Banks), *Isocapnia crinita* (Needham and Claassen), *Capnia coloradensis* Claassen, *Megarcys subtruncata* (Needham and Claassen), *Isoperla mormona* Banks, *Utaperla sopladora* Ricker, and *Calineuria californica* (Banks).

Distribution of 43 plecopteran species found along the Bow River is represented in Fig. 4. There was considerable variation in altitudinal distribution. Some species were restricted to either upstream or downstream sections, while a few species were found throughout much of the study area (e.g. the chloroperlids *Sweltsa coloradensis* (Banks) and *Alloperla severa* (Hagen).

Of 32 genera collected: 17 were represented by one species; 10 by two species; and five by three or more species. In general, ranges of congeneric species overlapped considerably (e.g. the perlodid species *Cultus tostonus* Ricker and *Cultus aestivalis* (Needham and Claassen) - Fig. 4), but there were some striking exceptions. For example, there was significant spatial separation between *Triznaka* species and between *Isoperla* species.

Nemourids and leuctrids were restricted to upstream areas (sites 1-9), while the other families of Plecoptera were represented throughout the study area (Fig. 4). Capniids were absent or reduced in abundance below hydroelectric dams (sites 8-11), especially the central dam (site 9 and 10, Fig. 4). Pteronarcids, capnids and perlids were absent or reduced in numbers downstream from Calgary (sites 12-14).

Figure 3 shows the total number of species collected at each site. Number of species decreased slightly downstream from both Banff and Canmore (sites 5 and 6). The fewest species were collected at site 9, 4.1 km below the central hydroelectric dam, and immediately downstream from Calgary (site 12). Approximately 30 km downstream from Calgary (site 15) number of species increased to levels similar to upstream sites, but then decreased sharply in an area that had no known environmental perturbations.

Stoneflies reached peak numbers downstream from Lake Louise (site 2), Banff (site 5), and near the upstream city limits of Calgary (site 11) (Fig. 3). The smallest number of specimens was collected below the central hydroelectric dam (site 9), and about 2 km below last sewage outfall from Calgary (site 12).

An arrangement of the 17 collection sites in relation to two axes by Bray-Curtis ordination is shown in Fig. 5. Four faunal associations were thus identified. Single associations occurred in the montane and subalpine vegetation zone, and in the general area of the boreal zone; two occurred in the grassland zone.

In order to obtain some information on reliability of our sampling method relative to number of species present at a site, and relative to the aquatic populations of Plecoptera found at a site, two comparisons were made. These are summarized below.

Fifteen plecopteran species were identified from site 11 where weekly samples were collected. If the normal bimonthly program had been carried out only 13 species would have been collected. The two species that were missed were represented by single specimens. Therefore, by doubling the sampling effort, the number of species found at this site was increased by 13%. Conversely, the bimonthly sampling program obtained about 87% of the species, and missed only those species that were very rare.

At two sites, one upstream, the other downstream from the town of Lake Louise (site 1 and 2, Fig. 1), larval stoneflies were collected by taking three kick samples at each site 15 times during 11 months of one year (Robinson and Smith Smith 1974). Identifications for this benthic study were made to subfamily, genus, or to species in a few cases. Using subfamily as the common level of identification, relative abundance of plecopteran larvae was compared to relative abundance of adults collected during the present study at these same sites (Table 1). This table shows that our method substantially underestimated relative abundance of Nemourinae, Isogeninae, and Acroneurinae at these stations, although our method obtained significantly more Capniinae. A comparison of taxa identified from these two studies indicated that the benthic study obtained 36% fewer taxa.

DISCUSSION

Comparison between adult and larval plecopteran collections from sites 1 and 2 on the Bow River indicated the two sampling methods obtained the same subfamilies but in different proportions (Table 1). Differences were probably related to vulnerability of species to either the

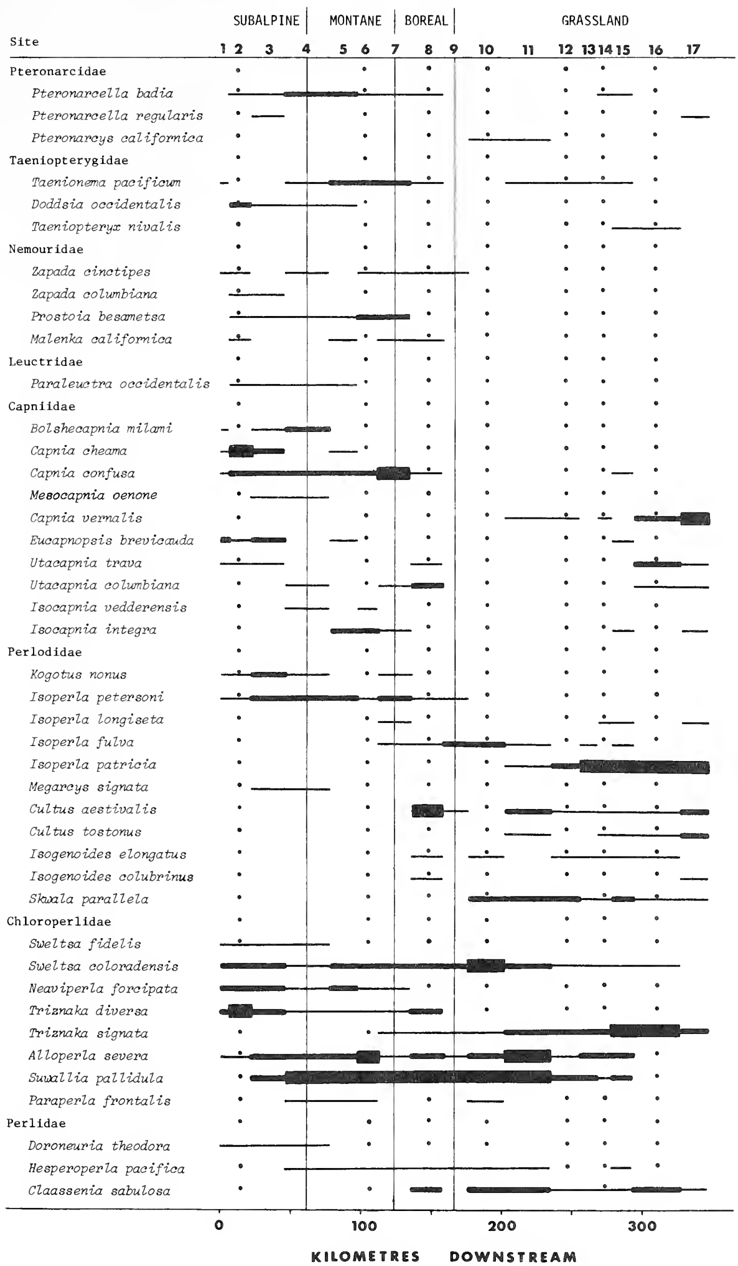

Figure 4. Distribution of 43 species of Plecoptera from Bow River. Abundance of each species is indicated by thickness of horizontal line. The thinnest line represents one to ten specimens collected, and thickest line represents 50 or more specimens. Nomenclature follows Baumann (1977).

TABLE I

PERCENT COMPOSITION BY SUBFAMILY OF BENTHIC[1] AND AERIAL PLECOPTERAN SAMPLES COLLECTED AT TWO SITES ON THE BOW RIVER

	Site 1		Site 2	
	Benthos	Aerial	Benthos	Aerial
Number of samples	15	11	15	11
Subfamily				
Nemourinae	16	6	18	4
Brachypterinae	+	1	6	4
Capniinae	11	31	6	26
Leuctrinae	-	2	-	1
Pteronarcinae	-	-	2	2
Isoperlinae	-	2	1	2
Perlodinae	6	1	25	3
Acroneuriinae	26	3	5	2
Chloroperlinae	41	54	37	58
Paraperlinae	-	-	+	
	100	100	100	100
Total number / m²	289		1397	
Total number collected		140		303

[1] Data compiled from Robinson and Smith (1974)
+ present; - not collected

benthic or aerial sampling method. Only rare species were added to the list of adult taxa found at site 11 when the collecting effort was doubled at this site. These data suggest that bimonthly collections of adult stoneflies approximate the relative abundance of aquatic and aerial stages at any given site. Adult collections are more suitable than larval collections for determining distribution of stoneflies because all specimens can be identified to species.

Bray-Curtis ordination identified four plecopteran associations from the study area (Fig. 5). Upstream and downstream limits of some associations were near boundaries of vegetation zones

found in the same area. Climatic factors that determined distinct vegetation zones also appeared to influence distribution of stonefly associations.

Plecopteran faunas in streams do not occur in discrete species groups. Typically, along the length of a river there is a progressive change in species with a broad overlap in distribution of many species (Knight and Gaufin, 1966, Donald and Anderson, 1977, and others). The majority of species in the study area were found in two or more associations. Only 13 of 43 common species were limited in their distribution to one of the associations (Fig. 4). However, Bray-Curtis ordination successfully identified those sites most similar to each other, and therefore ordination can be used to delineate parts of a stream that have a similar fauna or association.

In the following paragraphs, effects of hydroelectric dams and sewage effluents on species in the four associations (Fig. 5) are evaluated, beginning with the plecopteran fauna found in the subalpine and montane vegetation zone.

In the subalpine-montane zones (sites 1-7), there were changes in number of species and overall abundance of Plecoptera at certain sites (Fig. 4). Increase in abundance of Plecoptera downstream from Lake Louise and Banff was probably related to at least two factors: increase in discharge and width of Bow River at these sites (2 and 5), and to stream fertilization from organic sewage. An increase in the standing crop of benthos is typical of mild organic pollution (Hynes 1960). Sewage from the towns did not affect the overall distribution of plecopteran species with the possible exceptions of *Utacapnia columbiana* (Claassen) and *Kogotus nonus* (Needham and Claassen) (Fig. 4).

There was a major discontinuity in distribution of the stonefly fauna in the boreal vegetation zone. Seventeen species had either upstream or downstream distribution limits in or near this vegetation zone. A similar situation occurred in the near pristine Waterton River drainage where 58% of the common species had either upstream or downstream limits at 1235 m (± 100 m), the lower boundary of the montane zone (Donald and Anderson, 1977). These data suggest that discontinuity in species distribution near the downstream limit of the montane belt on the Bow River was due to natural changes in the lotic environment, and was not necessarily due to effects of sewage and hydroelectric dams in this area.

In the boreal zone there was a sharp drop in both diversity and abundance of stonefly species below the central hydroelectric dam (site 9, Fig. 3), followed by a gradual increase. It is well known that for the first few kilometres below large dams species diversity and overall abundance of stonefly larvae are reduced (Gore 1977, Radford and Hartland-Rowe 1971, Spence and Hynes 1971, Trotsky and Gregory 1974, Ward 1976). Data presented by Gore(1977) for a Montana river and by Ward (1976) for a Colorado river suggest that complete recovery of a plecopteran fauna occurs about 30-60 km below dams, although this recovery probably depends on many factors such as size of tributary streams, size of reservoir, daily variation in water release, and release of either epilimnetic or hypolimnetic water.

As indicated by reduced species diversity and abundance, site 9 was unfavourable for plecopterans. This site was 4.1 km below the hydroelectric dam with the greatest daily variation in discharge. Three other sites (8, 10 and 11) were located between 14.2 and 20.6 km below dams (Fig. 3). Dams have an unfavourable effect on plecopterans, and because three of the four dams in the study area were located in the boreal zone, it is possible that they were an important factor determining plecopteran faunal association identified from this section of the Bow River (sites 8-10, Fig. 5).

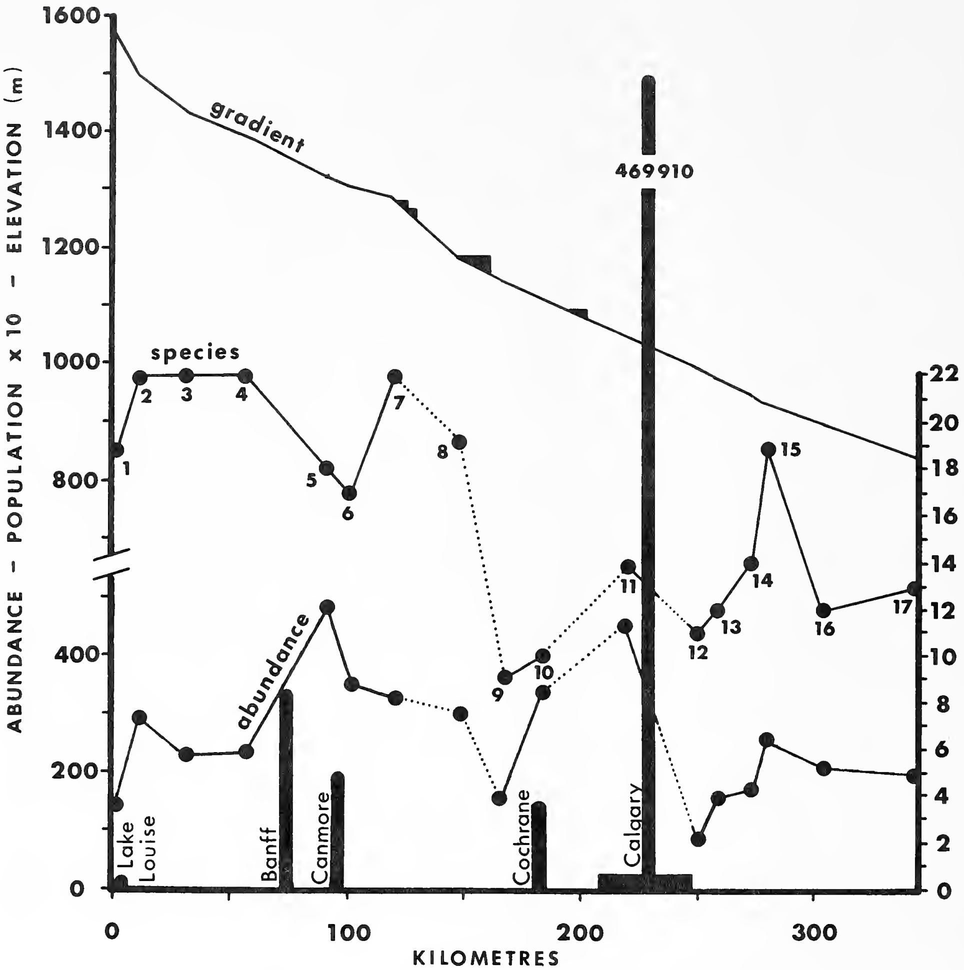

Figure 5. Scatter diagram of seventeen sites in the study area derived by Bray-Curtis polar ordination. Figure shows presence of four plecopteran faunal associations in the study area.

In other rivers in western North America, larvae of *Capnia vernalis* Newport and *Isogenoides colubrinus* (Hagen), (Gore 1977), *Pteronarcys californica* Newport (Elder and Gaufin 1973 and Ward 1976),*Skwala parallela* (Frison), *Claassenia sabulosa* (Banks), *Pteronarcella badia* (Hagen), and *Triznaka signata* (Banks) (Ward 1976) are absent from, or reduced in numbers below dams. Similar results were found for adults of these same species along the Bow River (Fig. 4).

In the grassland vegetation zone reduction in the plecopteran fauna occurred immediately downstream from Calgary (site 12). This part of the river received organic wastes as well as some thermal and toxic pollutants from Calgary. Deterioration in water quality in this area was indicated by a large increase in abundance of total coliform bacteria (Fig. 2). Many capniids, perlids, and pteronarcids were either reduced in abundance or were absent from this zone. Species completely eliminated from at least 26 km of river downstream from Calgary (sites

12-14) were *Pteronarcys californica* Newport, *Capnia confusa* Claassen, *Eucapnopsis brevicauda* (Claassen), *Utacapnia trava* (Nebeker and Gaufin), *Utacapnia columbiana* (Claassen), *Isocapnia integra* Hanson, and *Hesperoperla pacifica* (Banks). Four other species [*Skwala parallela* (Frison), *Isoperla patricia* Frison, *Suwallia pallidula* (Banks), *Triznaka signata* (Banks)] appeared to be tolerant of some organic pollution as indicated by their abundance two kilometres downstream from Calgary.

In general, stoneflies are intolerant of severe organic pollution and are usually eliminated by it (Gaufin 1958, Gaufin 1962, Gaufin 1973, Hynes 1960, Paterson and Nursall 1975). Stoneflies probably did not occur immediately below the city sewage outfalls. The relatively high stream gradient and high levels of dissolved oxygen in the Bow River contributed to a rapid recovery of water quality that permitted a few species to exist two kilometres downstream from Calgary.

Downstream from the last sewage outfall from sites 12 to 15 there was a progressive increase in the species diversity and abundance of Plecoptera (Fig. 3). This part of the Bow River was in a recovery zone where many species that were intolerant of the upstream effects of severe pollution once again reappear. Although the distributions of some species have not been greatly reduced (e.g. the perlid *Hesperoperla pacifica),* at least two capniid species (*Utacapnia columbiana* and *Isocapnia integra* have probably been eliminated by dams and sewage from more than 150 km of river (Fig. 4).

The sharp drop in species diversity, but not in abundance of stoneflies, at sites 16 and 17 in the grassland belt was probably due to natural conditions in the lotic environment that were unfavourable for some species of Plecoptera. Reduced gradient (Fig. 3) and high summer temperatures could be responsible. In the Waterton River drainage, distributions of *Capnia confusa* , *Eucapnopsis brevicauda* , *Taenionema pacificum* (Banks), and *Hesperoperla pacifica* did not extend far into the grassland zone (Donald and Anderson, 1977). These four species had a similar distribution in the Bow River. At least six other species represented at site 15, but not at Sites 16 and 17, have not been collected from rivers in south-central Alberta (Ricker 1943 and unpublished distribution records). These data suggest that change in the plecopteran fauna at sites 16 and 17 was due to natural changes in the lotic environment. The species represented at these two sites were identified as a second grassland association of Plecoptera (Fig. 5).

In this study, collections of adult Plecoptera were used to document patterns in distribution of stonefly species in the Bow River. Distribution of these species was influenced by hydroelectric dams, domestic and industrial sewage and by natural environmental factors (probably climate, river gradient, etc.). It follows, that in regions with a diversity of plecopteran species, the distribution patterns of adult Plecoptera can be used as an indicator of effects of severe organic pollution and hydroelectric dams on the lotic environment.

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SAWFLIES (HYMENOPTERA: SYMPHYTA) FROM GEORGE LAKE, ALBERTA

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ABSTRACT

Seventy-three species of Symphyta are recorded from George Lake, Alberta. Of this total, 66 species were collected by the author in a three day period in 1978, and seven species are recorded from the University of Alberta insect collection. Most species are found in eastern North America; only seven of the species recorded are known only from western Canada and United States.

RESUME

Soixante-treize espèces de Symphytes ont été inventoriées à George Lake, en Alberta. De ce total, l'auteur en a collectionné soixante-six au cours d'une excursion de trois jours en 1978. Les sept autres espèces se trouvaient dans la collection d'insectes de l'Université de l'Alberta. La plupart des espèces se trouvent aussi dans l'est de l'Amérique du Nord; seulement sept des espèces rapportées ici ne sont connues que de l'ouest du Canada et des Etats-Unis.

In 1978 I had the privilege of spending three days, June 1 to June 3, at the University of Alberta s George Lake Field Station about 50 miles northwest of Edmonton, Alberta. The area consists of about one square mile of forest bordered on one side by the lake and on the other sides by farmland. During this time, I collected 66 species of Symphyta. An additional seven species were found in the University of Alberta insect collection, bringing the total recorded from George Lake to 73 species. This is not a complete list, but a good indication of the number of species that can be found in a small area of mixed vegetation. A similar account was given by Strickland (1954) who collected 53 species of sawflies during a period of two weeks in an area of about a half square mile near Gull Lake, Alberta.

Most of the specimens were collected by sweeping or directly from the foliage along a forest trail to the lake, on the roadside and in a small cleared area with low vegetation. The remainder were collected by Malaise traps set up in the forest.

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All specimens were identified by me except for the *Pristiphora* which were determined by H.R. Wong. Those identified as "sp." or "spp." cannot be named until taxonomic difficulties in those genera are resolved.

Only a few generalities can be given about affinities of the sawfly fauna of George Lake, because this is not a complete survey and several species cannot be identified. Of the 55 identified to species, 47 are also found in eastern North America; of these 47, 17 are transcontinental in Canada and northern United States, 17 are both transcontinental and Holarctic, and 13 are primarily eastern, with Alberta on the western edge of their distributions. Consequently, most of the species from George Lake are the same as those one would expect to collect in southeastern Canada and northeastern and north central United States. Only one species, *Empria evansi*, is so far known only from Alberta. The other seven species are mainly western; these are *Birka nordica* (Alberta, Alaska, British Columbia, Yukon), *Dolerus nasutus* (Alberta and Montana to British Columbia and California), *Monardis pulla* (Saskatchewan and Colorado to British Columbia and Utah), *Allantus albolabris* (Alberta and Colorado to Alaska and California), *Macremphytus lovetti* (Alberta and Montana to British Columbia and Oregon), *Tenthredo fraternalis* (Alberta, British Columbia), and *Tenthredo varipicta* (Alaska to Alberta and California). Thus there is a slight mixture of some western species, but most species from George Lake are typical components of the eastern deciduous forests and temperate and boreal transcontinental regions. When all the material is identified, I would expect similar results.

In the following list (H) = Holarctic, those species or subspecies also found in parts of Eurasia and all of which are transcontinental in North America, (T) = transcontinental species or subspecies found only in North America, (E) = eastern species or subspecies for which Alberta is the western edge of their range, and (W) = species which are mainly western in distribution, mostly from the Rocky Mountains to the West Coast. An asterisk indicates a record from the Strickland Museum, University of Alberta.

PAMPHILIIDAE

Pamphilius ochreipes (Cresson) (T)

CIMBICIDAE

Zaraea inflata Norton (E)

ARGIDAE

Arge clavicornis (Fabricius) complex (H)

TENTHREDINIDAE

Selandriinae

Birka nordica Smith (W)

Dolerinae

Dolerus aprilis (Norton) (E)
Dolerus elderi Kincaid (H)
Dolerus nasutus MacGillivray (W)
Dolerus neocollaris neocollaris MacGillivray (E)
Dolerus sericeus sericeus (Say) (T)
Dolerus similis similis (Norton) (T)
Dolerus subfasciatus neoaprilis MacGillivray (T)
Dolerus yukonensis yukonensis Norton (H)
Dolerus sp.
Loderus eversmanni acidus MacGillivray (T)
Loderus pratorum albifrons (Norton) (H)
Loderus vestigialis apricus (Norton) (H)

Heterarthrinae

Fenusa pusilla (Lepeletier) (H)

Blennocampinae

Monophadnoides geniculatus (Hartig) (H)
Monophadnoides pauper (Provancher) (E)
Monophadnoides sp. near *conspiculatus* MacGillivray (E)
Phymatocera sp.
Monardis pulla Smith (W)

Allantinae

**Empria ignota* (Norton) (T)
Empria improba (Cresson) (T)
Empria maculata (Norton) (T)
**Empria obscurata* (Cresson) (T)
Empria evansi Smith (Alberta)
Ametastegia sp.
Monostegia inferentia (Norton) (E)
Phrontosoma broccum Smith (T)
Allantus albolabris (Rohwer) (W)
Allantus mellipes (Norton) (E)
**Macremphytus lovetti* MacGillivray (W)
Taxonus pallicoxus (Provancher) (E)

Nematinae

Priophorus morio (Lepeletier) (H)
Priophorus pallipes (Lepeletier) (H)
Fallocampus americanus (Marlatt) (T)
**Hemichroa crocea* (Geoffroy) (H)
Hemichroa militaris (Cresson) (T)
Pachynematus spp. (Two species that cannot be named at present. One of the two species should be marked *).
Nematus oligospilus Foerster (H)
Nematus spp. (Three species that cannot be named at present).
Pontania spp. (Three species that cannot be named at present).
Phyllocolpa sp.
Euura sp.
Amauronematus spp. (Five species that cannot be named at present).
Pristiphora borea (Konow) (H)
Pristiphora cincta Newman (H)
Pristiphora rufipes Lepeletier (H)
Pristiphora siskiyouensis Marlatt (T)
Pristiphora sycophanta Walsh (T)
Pristiphora zella Rohwer (E)

Tenthredininae

Rhogogaster californica (Norton) (H)
Pachyprotasis rapae (Linnaeus) (H)
Macrophya trisyllaba (Norton) (E)

Macrophya varia (Norton) (E)
**Tenthredo colon* Klug (H)
Tenthredo concessa Norton (E)
**Tenthredo fraternalis* (Ross) (W)
Tenthredo leucostoma Kirby (E)
Tenthredo piceocincta Norton (T)
**Tenthredo varipicta* Norton (W)
Tenthredo sp. near *pectoralis* Norton (T)

CEPHIDAE

Janus integer Norton (T)

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BOOK REVIEWS

GRIFFITHS, G.C.D. (Editor). Flies of the Nearctic Region. E. Schweizerbart'sche Verlagsbuchhandlung (Nägele u. Obermiller) Stuttgart, 1980.

The above gives editor, title, and publisher of a new series about classification and identification of the dipterous fauna of the New World (including Greenland, but excluding Iceland), from arctic North America south to the Isthmus of Tehuantepec excepting the Mexican coastal lowlands, and including Bermuda but not the other islands of the West Indies. This series was conceived and organized by the editor, Graham C. D. Griffiths, and is intended to be a counterpart of the monumental Palaearctic series "Die Fliegen der paläarktischen Region." Like the latter work, "Flies of the Nearctic Region" will be multi-authored, and will appear in numbered issues, organized in a hierarchy of Volume, Part, and Number. The sequence of numbering is based on a reconstructed phylogeny of the Order Diptera, with volume I to deal with general aspects. The taxonomic section is scheduled to appear in volumes II to IX, and each issue will treat a particular supraspecific taxon and its members. Numbers will be published in the sequence in which they are prepared, and subsequently can be grouped for binding, as Parts and Volumes are completed.

The first two issues are dated 1980, and I will review them after a few general comments.The paper covers are attractively rendered in two colors, with white and black print, and with an illustration of the head of a muscoid fly, apparently the logo of the series. Also included on the front cover is the logo of the publisher. The paper seems to be of good quality, but it is not high gloss. This, plus a clear, simple style of type, with justified right edge and generous margins, gives each page a pleasing appearance. Overall, one is left with the impression that printing mattters are in the hands of master craftsmen. Indeed, one can agree with a quotation from Thucydides that appears on page V, following the Foreword in Volume I: "This is composed more as a possession for ever than as a prize piece for immediate listening".

Volume I. Handbook. Part 1. History of Nearctic Dipterology, by A. Stone. XIII + 62 pp.

In the Foreword, the great master dipterist, Erwin Lindner gives a brief synopsis of his efforts to organize "Die Fliegen der paläarktischen Region", and extends his best wishes to G. C. D. Griffiths in his plans to produce a counterpart for the Nearctic Region. This brief salutation is folowed by a fine photograph of Dr. Lindner, with a statement dedicating the new series to him, on his 91st birthday.

The Preface, by Dr. Griffiths, acknowledges Lindner's work, and expresses the hope that the Nearctic counterpart will be completed by the year 2000. A map indicates the southern limits of the area covered, and a "List of Abbreviations for denoting locations of specimens" concludes the preface. I think it would have been desirable to include here the "Outline of proposed volume structure" that was published in an advertisement for the series.

In 60 pages, Alan Stone provides a remarkable array of historical data, focussed on study of the Nearctic fauna. In a section treating publications, he describes contributions by various authors to morphological, systematic, physiological, genetic, and economic aspects of flies. The "History of the Families" is a thumbnail sketch of progress made with study of each family, including for each, number of valid (and invalid) genera and species. This treatment of families, complete with bibliography, is followed by brief biographical sketches arranged

chronologically by date of birth, of 56 "leading dipterists", from Fabricius (1745) to Saether (1936). In this context, "leading dipterist" means one who has described 100 species or more of Nearctic flies. Words are well chosen, and statements are succinct. Overall, the presentation is descriptive rather than analytical or critical.

Dr. Stone suggests that these workers, though different from one another in many ways, probably shared in common "a boyhood interest in nature". Grouping them in quarters, he points out that "the first fourth, chronologically, proposed names for Nearctic Diptera in an average of 41 families;...the second fourth, 20 families;...the third fourth, 16 families; and the last fourth, 6 families". He identifies this as a trend to specialization that will probably continue, and that although application of new techniques might radically change entomology, "the enthusiastic naturalist turning a pinned specimen will long be needed".

Although Dr. Stone's treatment of historical aspects is rich and varied in detail, it lacks elements of association, that, if considered, would have provided the sense of continuity that history should convey. He acknowledges that "history ... includes the background and training of the scientist", but he does not draw attention to professor-student lineages. Perhaps none exist among dipterists, but if not, even this deserves comment. Nor does he consider explicitly, impacts of generalizing ideas on study of flies; for example, evolution, biological species concept, sympatric speciation, phylogenetic systematics as expounded by another master dipterist, Willi Hennig, vicariance biogeography, cytology, and so on. Be that as it may, the information he provides can be used by future workers, and the histories they write will be better because they will be able to build on the work of Alan Stone. Indeed, his contribution is a worthy beginning for "Flies of the Nearctic Region".

Volume V. Homeodactyla and Asilomorpha Part 13, Number 1. Bombyliidae, by J. C. Hall and N. Z. Evenhuis, pp. 1-96.

Included in this issue is an introduction to the Nearctic Bombyliidae, with keys to subfamilies and to the genera of Bombyliinae, and a taxonomic treatment of *Bombylius* and its 59 Nearctic species and subspecies. The key to these lower-ranking taxa follows the descriptive section.

Treatments of species include: synomyny; discussion of type material; description of structural features of adults; data about life history; and geographical distribution. The succinct descriptions are supplemented by good line drawings of male genitalia and spermathecae of females, and of wings of selected species. Illustrations are located near the descriptions that they are intended to supplement, and thus spread through the text.

No attempt is made by the authors to seek patterns of relationship. In fact, the treatments are arranged alphabetically by first letter of the specific epithets, so that one cannot infer anything from the sequence. A range map is provided for only one species (*B. anthophoroides* Evenhuis). Otherwise, one must attempt to visualize distribution patterns from a list of states from which each species has been recorded. Geographical variation is not mentioned, so the descriptions take on a rather typological air. The authors explain in the introduction that these and related topics will be considered at some future time. For the present, presumably, workers must be satisfied with what seems to be a rather uninspiring treatment, of interest mainly to specialists and to those who want to name their collections of bee flies.

I hope that future issues will provide treatments that have more general significance, but that retain the excellent style of presentation of Hall and Evenhuis.

Each of these numbers is costly: $38.50 for Part 1, and $44.40 for V.13.1, in U. S. dollars. But, recalling the introductory quotation from Thucydides and considering that one good meal

with good wine and served in a good restaurant, for one person can cost $25.00 (and up!), the issues of the "Flies of the Nearctic Region" are not unreasonably priced. Furthermore, their value is likely to increase with the passage of time. Certainly, dipterists must have the series, and entomological bibliophiles who wish to own fine publications will want it, too. For the rest of us, it might be a toss-up between buying various issues or investing in some other worldly pleasure. However, this series is worth having, and publisher, editor, and authors of the first parts are to be congratulated for their efforts.

G. E.Ball

HOWDEN, H. F. and O. P.YOUNG. 1981. Panamanian Scarabaeinae:Taxonomy, distribution and habits (Coleoptera, Scarabaeidae). Contributions of the American Entomological Institute, 18 (1): 204 pp., 216 figures. (Separates available from the senior author, for $15.00, U.S.).

According to the authors, this publication is a "review" rather than a "revision", for the taxa are described in terms of Panamanian material, only, and types of previously described species were not studied in detail. The stated justification for publication at this time is to provide a volume that will serve a need for identification of dung beetles by ecologists, ethologists, and economic entomologists who are or who might become interested in way of life of these animals. Scarabaeine adults exhibit complex behavior patterns in relation to use of dung, and are therefore of interest to many biologists. The unstated justification for this publication is the senior author's intense interest in and enthusiasm for the heavily armored, bumbling, horned monsters with disgusting alimentary habits, that are included in the Scarabaeinae.

In the taxonomic part of the paper, 22 genera and their 113 species are keyed, diagnosed, compared and described. Illustrations are included toward the end of the publication. Most are SEM photographs. They are adequate rather than elegant.

This paper contains a useful gazetteer providing for each locality mentioned in the text latitude and longitude, elevation (in meters), and relation to nearest major feature, so that a particular place can be located by those who have at their disposal only rather general maps of the area.

Figure 1 is an outline map of the Republic of Panamá, with provinces labelled and their boundaries indicated. Fig. 260 is a map showing elevations and Fig. 261 illustrates distribuion of forest types of life zones in Panamá. Thus, geographical aspects of this study are very well portrayed.

In a few pages, the authors provide insights about behavior patterns of some species and draw attention to aspects of behavior that require further investigation. These notes summarize the wealth of information that the authors were able to gather in two man years of collecting and observing in Panamá. This field work has enlarged and enriched their knowledge of tropical scarabaeines, and has given them insight that is denied to systematists who confine their activities to study of preserved specimens housed in museum drawers.

Distribution patterns of the scarabaeine fauna of Panamá are considered against a background of topographical and geological changes during Tertiary time. The species are

arranged in two major zoogeographic groups: endemics (in Panamá, or in Panamá and Costa Rica); and species that are more wide-ranging. In turn, species in the latter group are arranged in three subgroups: widespread (in other parts of Central America, Panamá, and South America); those in Panamá and South America, only; and those in Panamá and Central America, only. This last group, plus the Panamanian endemics, comprise the endemic Central American fauna, which represents 52 per cent of the total. The authors correlate this high rate of endemism in Central America with isolation, by seaways, of Central America from South America, during much of the Tertiary period. They infer that, during the time of isolation, differentiation took place. Further, they propose that species occurring now in both Central and South America attained the present ranges when the seaways were closed as a result of orogenies in Central America, leading to development of emergent land, and a terrestrial connection of the two areas. This proposed sequence of events accounts nicely for the observed patterns, and correlates well with inferences of various other recent authors, who have studied distribution patterns of other taxa in Middle America.

A more detailed examination of the data shows that average body size is smaller for members of Panamanian endemic species than it is for members of the wide-ranging groups. From this, Howden and Young infer that smaller size may be correlated with flight behavior as it relates to foraging, which in turn may relate to dispersal. Thus, the smaller species may be inherently less vagile than are the larger ones. Hence, they have remained in their areas of origin, that is, the areas that were above sea level during Tertiary times.

This is a reasonable explanation, but I wonder if more might be involved than dispersal ability. The small endemics might represent older, less progressive stocks, and might have remained in their areas of origin because they have been unable to compete successfully with later-evolving, more progressive stocks comprised of species whose adults attain large size. To test this hypothesis, a phylogenetic analysis of the scarabaeine fauna of Middle America is required, and this the authors have not undertaken– nor do they recommend such an analysis. In my view, this is an unfortunate oversight, for the missing system of hypotheses limits markedly ability to interpret the zoogeographic data.

In spite of this one omission, the publication overall is fine, and contains information of value to a wider range of biologists than those who wish to identify their Panamanian scarabaeines. It should be on the shelves of coleopterists in particular, systematic entomologists in general, ethologists, and biogeographers.

G.E. Ball

Reigert, P.W. 1980. From arsenic to DDT: A history of entomology in western Canada. xii + 357 pp. University of Toronto Press. Price:$30.00. ISBN 0-8020-5499-4.

Perhaps more than any other group of scientists, entomologists revel in writing histories of themselves and their science. Although some of these (e.g. Mallis, "American Entomologists"; Weiss, "The Pioneer Century of American Entomology") briefly mention Canadian entomology, Riegert's book represents the first attempt to collect the history of entomology in any part of Canada in one place. The book is organized into four parts encompassing 20

chapters. "Early encounters"(Part I) describes problems encountered by early explorers(e.g. Hearne, Palliser, Henry, Thompson), boundary surveyors and settlers with biting flies and grasshoppers. This section is perhaps the most interesting in the entire book. Riegert makes good use of quotes from various travellers that help in conveying a sense of the real suffering endured by these people. The section concludes with a chapter about collectors and naturalists. Part II("The first professionals") describes the beginnings of the federal and provincial entomolgical services. It traces the efforts of such notables as Fletcher, Hewitt, Criddle and Strickland in establishing pest monitoring and control programs. Part III ("Insects of British Columbia") follows the work of such people as Hearle, Downes, Glendenning, and Buckell in controlling various crop pests, mosquitoes and grasshoppers. It concludes with a short chapter about insect pests of Indian orchards. Part IV is entitled "Insects of the prairies" and deals in great detail with outbreaks of wheat stem sawfly, various species of larvae and, above all, grasshoppers. In fact, nearly 25% of this book is devoted to grasshopper outbreaks. Such figures as King, Strickland, Criddle, and Seamans are prominent. Part V(Specialization) has chapters dealing with livestock pests, stored products pests, entomology in universities and a summary chapter. Parts II through V deal with pest control problems(except Chapter 19). They are written in a clear, unambiguous, though rather mundane style that traces pest control incident by incident. These sections are livened every now and then with anecdotes but these are few and far between. There are several odd inclusions that seem to be afterthoughts. Chapter 17(Pests, paralysis and plagues) ends with an account of *Grylloblatta campodeiformis*(see below), an insect species that is not a pest and has nothing to do with paralysis or plagues. Chapter 16 is entitled "Worms". The choice of title is poor. The animals described are not worms(e.g., Annelida, Cestoda, Platyhelminthes etc.)' and use of this term is misleading to lay readers, unnecessary for entomologists and wrong for both.

There are more general problems that seriously compromise this book. The first is one of mistaken emphasis. Riegert states(pp. 4) "Because this is a history of entomology and not a history of entomolgists, the present chronicle will follow insects rather than man...." is unfortunate for it is the people who study a science that breathe the life into it: it is their ideas, foibles, frustrations and passions that make history. Dr. Riegert's insistence on using insects as the main characters excludes most information that would make the people involved seem more real. There are tantalizing anecdotes about William Downes and Eric Hearle that hint at some interesting facets of their character but these are not pursued. The team of E.R. Buckell, A. Dennys and A.D. Heriot are described as "the most colorful that Canadian entomology has known" but little of this colour is brought home to the reader. I was left perplexed by this since other historical essays by Riegert(e.g. Proc. ent.Soc. Alta. 25: 4-15) have far more personality written into them. Questions of how the strengths, weaknesses, personalities and interactions of these men helped (or hindered) the development of entomology are left largely unexplored. Using insects as the focus for this book also leads to a disconcerting lack of continuity. The narrative leaps from one insect outbreak to another and it is difficult to gain any appreciation of the flow of events.

The second problem is one of imbalance. This is, in the main, a history of *applied* entomology. Those who study insects with satiation of intellectual curiosity rather than pest control as their goal will find little to identify with. For example, the life of F.H. Wooley Dod, described as "one of the two leading Lepidopterists on the North American Continent", rates the same amount of space as an account of how a mixture of arsenic bait for grasshoppers was prepared. At one point(Chapter 10), entomology is even forsaken for a nearly two page

discourse about control measures for moles and garden slugs. On the other hand, Strickland's building of a "world-renowned department[of entomology]" at Alberta receives less than a page in the entire book. Acknowledged leaders in entomological education such as J.G. Rempel(University of Saskatchewan) are dealt with in a cursory manner that borders on gratuitous. Instead we are supplied with tiresome detail of control campaigns(proportions of ingredients for bait mixtures, quantities of bait spread, dollar value of crops saved)that has its place in technical reports but is of doubtful value here.

The third problem is one of omission of several important events and people. Two of the earliest naturalists in Canada were James Isham and Alexander Graham at York Factory(Manitoba). Neither are mentioned even though there is a very interesting story of Graham's data being pirated before its inclusion in Pennant's "Arctic Zoology". E.M. Walker's discovery of *Grylloblatta campodeiformis* near Banff, one of the major taxonomic discoveries to be made in Canada, is not mentioned although a range extension of it by J. Gregson into British Columbia is.

The final problem is one of editing of both text and figures. There is simply too much use of quotes from reports of various federal entomology labs. In places(e.g., Chapter 15) perhaps one third of the text has been written by other people. Many quotes used contain details of control measures, crops saved, costs etc. whose omission could only enhance readability. The choice of the 57 plates in this book is puzzling. For example, James Marshall, mentioned only at one point in the book is shown, yet William Downes and Reginald Glendenning, each of whom commands an entire chapter of text, are nowhere to be found. The plates are not numbered and are grouped at the beginning of each section. Hence, any reference to them in the text is followed by a frustrating search for the relevant illustration. Another curious anomaly is that, except for line drawings on reproductions of posters and one picture of several hundred mosquitoes on a fence post, there are no pictures of insects in the book. This omission is puzzling in a book that is oriented to the insect and not the entomologist

Dr. Riegert has written a book whose cover promises more than the text delivers. The subtitle implies a more even treatment than appears. The main title would lead a non-entomologist to reasonably expect some insight into how scientists intimately connected with DDT view its use and associated controversies. In fact, DDT is mentioned only four times and then only in passing.

The word 'history' is 70% story. Hopefully any history will tell a story and not just recite events. Unfortunately this book does the latter.

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MATTHEWS, E.G. 1980. A guide to the genera of beetles of South Australia. Part 1. Archostemata and Adephaga. Special Educational Bulletin Series, South Australian Museum, Adelaide. vii + 50 pp., and 18 unnumbered plates of photographs.

Although policies of the Australian Government make it difficult for a foreign entomologist to remove insect specimens from that country, that same Government is not opposed to

encouraging excellent foreign entomologists to take up work there. Thus, we find on the staff of the Commonwealth Scientific and Industrial Research Organization (CSIRO) and other Australian institutions, a number of recent immigrants to the island continent, who are doing excellent work on the indigeneous fauna. One of these entomologists is Eric G. Matthews, curator of insects in the South Australian Museum, Adelaide. Dr. Matthews, who took his PhD at Cornell University, with Howard E. Evans, and who subsequently immigrated to Australia, is well known for his excellent studies of dung-using scarbaeid beetles. This present volume, written by him, is the first in a series intended to provide a means of identifying to genus adult beetles that inhabit the state of South Australia.

An Introduction provides a succinct history of study of Australian beetles. Statistical information is summarized by means of a graph, plotting numbers of papers published about beetles, against year of publication. A peak of activity is indicated in the latter part of the 19th and first decade of the 20th Century, labelled "descriptive stage", and followed by a decline with its low point being the years of World War II. This is followed by a second, less pronounced, rise in acivity, entitled the "revisionary stage". This is a useful summary of much information for historians of entomlogy.

The Introduction explains that this and subsequent issues deal with adults of genera and higher taxa only, and that much remains to be learned at all levels, but especially at the species level. Estimates of numbers of taxa are given for South Australia (1000 genera, 3200 species), representing about 16 per cent of the Australian total. Advice is offered about study of beetles, and two plates illustrate collecting and curating equipment and methods.

The next section includes a map of South Australia, with life zones indicated thereon. This section also explains how the book is structured, and how it is to be used for identification of genera. The focus is on picture keys, spread over 29 plates. These drawings are well executed, and diagnostic features are clearly labelled. The main portion of the text is an annotated list of names of genera and higher taxa, arranged in standard taxonomic sequence. For each genus, the number of South Australian species is listed, along with the life zones in which specimens have been collected. References are given by taxon to other publications, to the picture- key, and to habitus photographs. In the equivalent space of six full pages, all of the taxa are thus treated: Archostemata- Ommadidae (one genus); Adephaga- Carabidae (78 genera); Haliplidae (one genus); Hygrobiidae (one genus); Dytiscidae (22 genera); and Gyrinidae (three genera).

The photographs are sharp, and give good impressions of the habitus of adults of each genus. Each plate has six photographs, and each photograph has a reference number and the appropriate specific name. Size of the beetle illustrated is indicated by a number representing length of the specimen, in millimeters.

An index to names of genera and higher taxa is provided, making it easy to locate desired information.

The cover is stiff, gloss paper, and on the front is a colored photograph of a male of *Megacephala*. The frontispiece is a color photograph of a living specimen of *Calosoma schayeri* Erichson.

This volume was clearly conceived and superbly executed. It is a masterpiece of clarity and brevity. Author, publisher, and printer are to be congratulated for producing a work that will no doubt stimulate development of amateur entomology in Australia, and will be of use to entomologists elsewhere who have an interest in Australian beetles.

G. E. Ball

EDITOR'S ACKNOWLEDGEMENTS

Pogo, the late Walt Kelly's philosophically inclined possum friend from the great Okefenokee Swamp, was able to demonstrate the relativity of time of occurrence of special dates by noting that Friday the 13th did not invariably arrive on days normally designated as Friday. In fact, it was a cause for celebration by Pogo and the other denizens of the Great Swamp when Friday the 13th fell on Friday.

Extending this example of relativity almost to absurdity, the publishers of *Quaestiones Entomologicae* have demonstrated that October, 1980 actually fell in July, 1981, for that is the month and year of publication of Volume 16, Nos. 3 and 4–the July-October issue for 1980. I suppose that instances such as this and variations in day of arrival of Friday the 13th are special cases of the General Theory of Relativity.

While that explanation has appeal in the dark corridors of our publishing house, subscribers are not likely to accept it as a reason why the issues for which they have paid good money (or a pile of shin plasters, in Canada) have been so late in arriving. In fact, as Editor, I consider myself lucky to be practising in an era when horsewhipping of members of my guild by disgruntled subscribers has gone out of fashion–this form of expression of displeasure owing its demise to a shortage of buggy whips which in turn went the way of horse-drawn vehicles.

Contributing to the time-warp alluded to above, were delays encountered in our efforts to produce our first two issues for 1980, which included "The Hydraenidae of the Western Hemisphere". I am still amazed that such an elephantine volume can be devoted to classification of such micro-lilleputian creatures. But, like Gulliver, in the land of Lilleput, we became indeed tied down, not by anything big, but by numerous small delays and minor problems.

It required about 19 months to produce this volume about hydraenid beetles– this being just about the gestation period of elephants. When we saw the first bound copy, my colleagues and I went into a state of mild euphoria, with feelings rather akin, perhaps, to those of a herd of pachyderms when a new youngster is born and joins the troop. I am pleased to say that this 544 page elephant child was not at all wrinkled!

Three Publications Managers were involved consecutively in working on the hydraenid volume: Mrs. Twyla Gibson, Mrs. Jane Ballash, and Mrs. Suseela Subbarao. I am grateful to each of them for their contributions. I am especially grateful to Mrs. Subbarao, who saw to completion the hydraenid volume, and as well the long delayed subsequent issues for 1980. The author, Philip D. Perkins, is to be commended, too, both for his patience with our delays and for having prepared this fine treatise.

I record appreciation of the efforts of the following, who acted at my request as referees of papers published in Volume 16:

A. P. Nimmo, Department of Entomology, University of Alberta;

K. W. Philip, Institute of Arctic Biology, University of Alaska, Fairbanks, Alaska;

J. R. Spence, Department of Entomology, University of Alberta; and

H. R. Wong, Environment Canada, Canadian Forestry Service, Edmonton, Alberta.

Various members of my Department assisted with the publishing process. Jean-Francois Landry provided French translations of several abstracts. John S. Scott helped with illustrative matters , and he and Danny Shpeley read quantities of proof.

In view of the long delay experienced by our loyal subscribers in receiving the issues of Volume 16, I record our gratitude for patience and continued support. I cannot promise that we will be able to get out the journal on time, once after the back-log has been cleared, but we will do the best we can.

George E. Ball

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Publication of *Quaestiones Entomologicae* was started in 1965 as part of a memorial project for Professor E. H. Strickland, the founder of the Department of Entomology at the University of Alberta in Edmonton in 1922.

It is intended to provide prompt relatively low-cost publication for comprehensive accounts of entomological research of greater than average length. However, shorter papers about insects in the Prairie Provinces of Canada are acceptable. Page charges are normally levied, the rate determined by printer's charges. For information about current page charges, consult the Editor.

Copy for all types of papers should conform to the Style Manual for Biological Journals, published by the American Institute of Biological Sciences, Second Edition, 1964, except that titles of periodicals should be given in full. For style of taxonomic papers, the Editor should be consulted. Two copies of a manuscript are requested. All manuscripts will be reviewed by referees.

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